The Education System and Labour Market Integration of Immigrants

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Abstract

Over the years, we have witnessed a radical shift from traditional family structures to new family structures like single-parent, skipped-generation, and immigrant households. Parents are raising their children against a backdrop of widely diverse and constantly evolving family structures. Alongside such change, the world has continued to witness an increasing number of immigrants, which has immensely contributed to the increasing number and sizes of immigrant families. It is crucial to address the issues related to immigrant families, primarily as a result of the changing attitudes and values surrounding immigrant families and consequently their increase in number. Moreover, the dual-culture of immigrant families poses more challenges and barriers to immigrant families as they try to integrate into the host country. Their integration of immigrants into the education system faces a number of challenges, for example, their lack of proficiency in the host nation's official language. Besides, their learning experiences in the host country ultimately impact their long-term labour market integration. Thus, in this line, this dissertation focused on these two forms of integration. We examined the relationship between children from different family structures and their cognitive knowledge, focusing on children in Taiwan, and found that children from two-parent families have the highest test scores. Compared to children from two-parent families, children from skipped-generation households and single-parent households perform worse, while children from immigrant households tend to perform even better than children from traditional two-parent families. We also evaluated the test score differentials between children with single mothers of different nationalities and those of two-parent families, and found that children with either immigrant single mothers or native single mothers perform poorly. Among children of immigrant single mothers, children with mothers from Mainland China perform better than children with mothers from Southeast Asia or other immigrant mothers, owing to the fact that mothers from mainland China share the same mother language as Taiwan, which means that mothers are more likely to be involved in their children's learning process. This dissertation also focused on how the differences in cognitive and non-cognitive ability result in the differences in the pace of immigrant integration into the labour market, evaluated using individual income and income growth. It was established that, on average, cognitive skills have a significant impact on individuals' income, although they are economically insignificant, while cognitive skills do not play a role in their income growth. On the other hand, we found that non-cognitive

skills have an insignificant impact on income and income growth. In addition, it was found that non-cognitive skills play a role in explaining income inequalities and income growth differences between immigrant groups, while cognitive skills only play a role in explaining income growth differences between immigrant groups.

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Declaration

I confirm that the results presented in this dissertation come from my own work and that I have not presented the work of others, and that full and appropriate acknowledgements have been given when references to the work of others have been made.

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Chapter 1

Introduction

1.1 Introduction

The face of the family structure has in recent years undergone a shift with increasing deviations from the traditional two-parent families to single parents, skipped-generation households, and immigrant households [371]. These changes are attributed to factors such as globalization, urbanization, occupational mobility, increased cases of marital dissolution and financial independence especially among women. Markedly, increasing cases of migration globally have fostered an increase in the growth of the immigrant population while financial hardships and high levels of unemployment contribute to the increasing number of skipped-generation households [242]. Also, high rates of divorce globally contribute to the increase in the number of single-parent households [302]. Compared to the emerging new family structures (immigrants, single parents and skipped-generation households), the growth of the traditional two-parent family structure is relatively lower. Of the above named family structures, single-parent households and immigrant households record a higher percentage increase compared to the skipped-generation and two-parent family setups. Parenting styles, socio-economic status, as well as ease of access to resources differs with the type of family structure [367].

Among the emerging non-traditional family structures, the immigrant family structure stands out compared to the skipped-generation and the single parent structures [93]. To this end, while both the skipped-generation and the single-parent family structures are able to maintain the cultures of their countries despite the change in familial functionality, immigrant households are characterised by dual cultures in that they maintain their tra-

ditions but are still aware of the culture of their host countries [425]. As a consequence, immigrant families face overwhelming challenges in terms of adapting to the new cultures as they strive to reconcile their culture with that of the foreign country. The immigrant family structure makes a viable cohort for this study in that compared to the other non-traditional households; they face immense challenges and barriers [124]. In addition to barriers associated with social, cultural and religious integration, immigrant families further face challenges such as language barriers, high levels of unemployment, societal and systemic biases, as well as challenges in accessing essential services [367].

Within migrant families, experiences of acculturation - the process by which migrants assimilate to a difference culture - have been found to vary. For example, Benedetta et al. [340] suggest that children may be more likely to assimilate towards the culture of their host country than their parents. Further, immigrant parents are also faced with problems when it comes to raising their children due to their bicultural nature. Challenges associated with cultural identity among immigrant children contribute to the negative stereotypes that are common, especially for school going children [425]. As such, immigrants may face challenges to cultural integration, but also to further find common grounds when establishing their place in the society. As a result, the experience of immigrant families may be characterised by higher levels of poverty and financial constraints compared to other non-traditional family or household structures.

Additionally, relative to the skipped-generation and single-parent structures, immigrant families can lack the familial and societal support necessary for their growth and development socially, culturally, and economically in the host countries [425]. For example, challenges such as language barriers often experienced differently within immigrant families may act as an impediment to the parents' involvement in their children's education. In some cases, it has been suggested that this may contribute to the poorer performance of immigrant children [302]. Given the growing number of immigrants in many countries, it is important to understand the opportunities and constraints encountered by immigrant families [371].

The selection of the immigrant family structure for this study is also based on the need to analyse and comprehend the nature of education and labour market performance of immigrant families. Comparatively, other non-traditional family structures (single and skipped-generation households) are not necessarily affected by the need for education integration and labour market integration, which is the case with immigrant families. Also, unlike other non-traditional family structures, immigrant families are in some cases re-

jected from the host countries by natives on the basis of religion, race and culture [428]. In most cases, immigrant families require the intervention of the host government in terms of the initiation and implementation of policies that work towards accommodating immigrants and their children in their respective societies through education integration, social and cultural integration, as well as integration in the labour market. As such, based on the broadness of immigrant families in terms of context, they make for a better research cohort compared to the other non-traditional family groups.

One of the most pressing issues facing immigrants and their children is the need for education integration aimed at enhancing the academic performance, as well as accommodating immigrant children in the system of education [194]. Accordingly, immigrant children face myriad challenges in terms of limited external cultural stimulation, lack of social capital, language barriers, and education policies, which have a long-term effect on their academic abilities [277]. Essentially, there is need for the implementation of policies and programs that seek to provide financial aid, as well as remedial programs with special provisions for immigrant children in order to boost their academic performance.

However, while there is extensive literature exploring the issue of academic performance of immigrant children, the literature is characterised by gaps. For instance, most of the research studies on the matter compare the scholarly performance of immigrant children to that of children from two-parent households [256]. Markedly, such findings negate the impact of the changing family structure and fail to identify the emerging non-traditional family structures such as the skipped-generation and single-parent households. To this end, the research fails to consider the children's academic performance across all types of family structures. Further, most studies exploring education outcomes among immigrant children are keener on comparisons of immigrant children from families where one of the parents is an immigrant and the other is a native [104, 160]. Such studies contend that the poor academic performance exhibited by children from such families is as a consequence of language barrier by the immigrant parent, which affects the children's academic abilities. However, the disadvantaged academic performance of some children in immigrant families may not be due to the language proficiency of their immigrant parent. Considering alternative family structures within migrant households may shed more light on what shapes or contributes to differences in educational attainment for children of immigrant households.

The labour market integration is another immigrant issue that is vastly researched on the basis of comparisons of labour market outcomes of the immigrants to that of natives. The labour market is characterised by differential patterns in participation and employ-

ment, which is further accompanied by widening gaps in the labour market outcomes between immigrants and natives [404]. The listed factors affecting the integration of immigrants in the labour market include differences in skills, language barriers, and biases that are systemic and societal in nature [19]. The trajectory of labour market integration is largely influenced by human capital accumulation [207]. Human capital accumulation in this case encompasses a mix of both cognitive and non-cognitive abilities such as literacy, one's ability to solve problems, numeracy, social trust, perseverance, and critical thinking [447]. It may then be assumed that differences in the pace and extent of labour market integration for migrant groups is related to differences in the development of cognitive and non-cognitive skills.

Findings from research studies and literature addressing the immigrant's labour market integration is characterised by gaps. For instance, in much of the literature exploring the gaps in labour market integration between immigrants and natives, differences in cognitive abilities is listed as the main challenge hindering the integration of immigrants [75, 92]. However, these studies neglect the impact of non-cognitive skills in labour market participation and performance. Non-cognitive skills are critical in the workplace in terms of boosting motivation, and enhancing collaboration and effective communication [289, 62]. Further, drawing from the concept of human capital accumulation, non-cognitive skills may be as important as the cognitive skills when it comes to elevating the value of a worker in an organization [369, 429]. This study identifies the importance of non-cognitive ability on the extent of immigrant integration and the need for creating and implementing policies that create more opportunities for immigrants in the labour market. To this end, it is imperative for host governments to initiate training programs for immigrants that foster both cognitive and non-cognitive abilities that are required in the labour market. This will go a long way in ensuring that immigrants are not concentrated in the low-skill jobs in addition to ensuring that they are effectively integrated in the labour market [370, 327].

The aims of the dissertation are listed in Section 1.1. In establishing the overall aims of this dissertation, Section 1.2 provides background information on immigration trends in the two major countries used in this study, Taiwan and the UK. The dissertation structure is organised in Section 1.3.

1.2 Dissertation aims

This study uses a life course perspective to understand the integration of immigrants into

their destination country. We investigate two aspects of integration, including their education system integration during the adolescence stage and their labour market integration during their later life. We start by investigating the relationships between family structures and academic performance of children in order to understand the situation of integration in childhood and adulthood. The focus is then on the performance of immigrant groups in the labour market in terms of understanding integration for later life. These studies jointly offer a continuous study of integration from childhood to adulthood and later life success for immigrants. Three aims of this dissertation are arranged as follows:

1. To establish the relationship between various forms of non-traditional household structures and educational outcomes for children.

2. To determine the extent and association of immigrant single-mother's nationality and their children's academic performance.

3. To examine the difference in the pace of integration amongst immigrant groups and whether differences in cognitive and non-cognitive skills contribute to differences in the pace of migrant integration into the labour market.

1.3 Background information of immigrant trends

In order to achieve the objectives in a coherent and integrated manner, it is necessary to have the complete background knowledge of the immigrant history and trends of the countries on which we have focused in this dissertation. We are using Taiwan to investigate the integration of immigrants into the education system. On the other hand, the UK is used to investigate the integration of immigrants into the long-term labour market.

1.3.1 Immigrant trends

Historically, individuals have constantly been moving. In the past ten years alone, the number of migrants has steadily grown, going past the global rates of population growth [320]. As reported by the UN, in 2017, the number of international migrants worldwide stood at 258 million, translating to about 70% increase in comparison to the year 1990 [324]. Of the migrants, close to 68 million were forcefully displaced individuals, comprising of more than 3 million individuals seeking for asylum and about 25 million refugees [324]. Also, as reported by Kuhnt [261], the share of global migrants in the globe's population has

risen from 2.8% in 2000 to 3.5% as of 2019. The consequent rise in the number of migrants globally has transformed migration into a demographic process with rising political and social resonance [261]. Thus, this suggests that population is shaped by migration flows.

Taiwan immigrant trends Taiwan and Mainland China both locate in East Asia, between which the shortest distance is only 125 kilometres. Despite the geographical closeness, not until the relatively massive migration from China since the 17th century, these two areas share similar but yet distinct history. Taiwan also has an intimate relationship with other countries in her history. Spain and Netherland both established their colonies in the Northern and Southern part of Taiwan in the early 17th century. However, these colonies failed to continue after fierce competition, among which either with each other or with the armed force from China. The armed forces from China established the Kingdom of Tungning in Taiwan. This kingdom then lost its govern after being defeated by the Qing Empire (the ruler of Mainland china), and it started a long period under the rule of Qing China since 1683. However, Taiwan was ceded to Japan on April 17, 1895, due to Qing's loss against Japan in the Sino-Japanese War. The rule of Japan only lasted 50 years. As the close of the World War 2, Japan lost its right in Taiwan, and Republic of China took over the governorship in Taiwan till now.

The globalisation and economic development of Taiwan from the 1980s has come with a primary societal change: a progressive globalization of the household. In 1987, the martial law was abolished, which lifted the harsh regulations regarding the visitation of relatives in China. The following year, the first permission of Chinese Mainland wives of Taiwanese husbands to go to Taiwan in 1992 resulted in the first wave of marriage between Taiwanese men and Chinese Mainland ladies. As of 2003, the yearly number of registered marriages involving spouses from Mainland china had got to 34,685, which translated to around 20.2% of all the marriages recorded in the same year [283].

Between 2007 and 2009, 20% of all foreign-born wives in the country came from Vietnam, though Mainland China, due to the language affinity with Taiwan, continues to be the most significant bride source. As pointed out the country's Ministry of Interior, in 2007, there were about 24,700 marriages between non-Taiwanese women and Taiwanese men, representing 18.3% of all marriages and bringing the general number of foreign-born wives in the country to 372,741 [283]. By January 2010, the number of non-Taiwanese brides had risen to 401,585, with most of them from Mainland China (65.5%), Indonesia (6.5%), and Vietnam (20.5%) [283]. Comparatively, in 2007, there were only 31,807 mar-

riages in Japan between non-Japanese brides and Japanese grooms, translating to about 4.4% of all marriages [283]. In recent two decades, marriages across countries have become an unstoppable trend in Taiwan, and their influence on Taiwan society should be concerned much than ever. According to statistics compiled by the Ministry of the Interior, there are around 797,122 foreign residents live in 2020, more than twice that of 2000. From 2000 to 2020, female foreign residents exceed male foreign residents. Also, among all foreign spouses in Taiwan, the number of married female foreign residents is over ten times that of married male foreign residents. In 2020, there are 514,118 married female foreign residents, while only 51,181 married male foreign residents.

With regard to long-term demographic impacts, foreign-born brides are regarded as permanent immigrants, contrary to foreign contract labourers who ought to leave Taiwan after a particular time, essentially contribute to the population growth of the country. In line with Wang [419], the level of education of Taiwanese men marrying non-Taiwanese spouses is senior or junior high school. As cited in this research, a survey by Wang [418] on Taiwanese grooms and non-Taiwanese brides established that women are close to 12 years younger than their spouses and are less educated, with a majority not being educated beyond six years of elementary school [418]. Moreover, Tsai [407] shows that a huge population of Vietnamese, Chinese, and Indonesian immigrant female move to Taiwan to marry men of a 'lower social class'. As pointed out by Wang [419], it appears that the importation of brides and marrying foreign women is a strategy amongst Taiwan men improving their families in different dimensions.

The number of foreign brides has been increasing tremendously, and consequently, there has been a sharp rise of immigrant households over the years. As reported by Ho [219], the percentage of immigrant children in Taiwan elementary schools stood at 2.91% in 2005 and has risen steadily ever since, for instance, it stood at 9.78% in 2010 [219]. Also, according to a survey conducted by the Department of Statistics of the Ministry of Education, the number of immigrant students at 8th grade increased from 2,318 in 2005 to 20,958 in 2019. Among 20,958 8th grade immigrant students, around 36% are immigrant children with one of their parents is from China, while 60% are immigrant children with one of their parents is from Southeast Asia. The other 4% are with parents from other countries such as Japan, the USA, South Korea and others. An unprecedented experience and a unique immigrant trend for modern Taiwan, the influx of immigrants requires more attention to be paid to the education of immigrant children.

Combined with economic development, feminist movements, and population migration,

the traditional family structure of Taiwan has experienced dramatic changes [264]. Due to Taiwan's sky-high divorce rate, the number of single-parent families has increased dramatically in recent years. Moreover, some studies concluded that the increase in dual-career couples and unbalanced modernization in urban areas led to the emergence of skipped-generation households [443, 190]. Much of the current parent generation comprises dual-career couples with little time for child care, which acquires more roles of grandparents in raising children. Moreover, transnational marriage is a reason for immigration, as globalization continues at a rapid pace. It has become a trend in Taiwan society. As a result, the number of immigrant families is growing [280].

Therefore, Taiwan provides a good basis for researchers to evaluate the issues related to immigrant families. Drawing on Taiwan's unique immigration pattern, we explore the barriers and challenges faced in immigrant families and further evaluate the performance of children growing up in an immigrant single-mother family.

UK immigrant trends Britain is well known for its history of immigration, which can be connected to many historical events (such as the invasion of Romans in 1st century BC and the migrations of Anglo-Saxons started from 5th century). With regards to the modern evolution of European history, there is still an influx of people from other countries into Britain. The refugees from other places in Europe had already played out during the earlier 20th century. In the lead-up to World War 2, many minorities (like Jews) emigrated from Germany and Austria, by which time they were under the rule or influence of Nazi.

After the war, the British Nationality Act 1948 allowed the people in the British Empire to live and work in the UK without a visa [196], for though the expansion of immigration policy is meant to fill the gap with need in labour market [385]. This change generated enormous emigration from previous territory of the empire, and led to restriction of immigrants later. Many debates and works on legislation have been engaged to address the immigration issue. Eventually, the Commonwealth Immigration Act 1968 was made to first require migrants to have a connection to a UK national by birth or by ancestry. The Immigration Act 1971 further regulated those with work permits or people with parents or grandparents born in the UK are eligible to enter, and this effectively stems main immigration from Commonwealth countries [58]. In addition to people from Commonwealth countries (e.g., Indians and Pakistan), there are still other sources for immigration to the UK after the end of World War 2. Substantial people from territories controlled by Soviet settled in the UK, especially the Poles and Ukrainians, and these displaced people

coincidentally fill the labour demand to industries for economic recovery of the UK [248].

Another steam of migrants is from other countries in Europe. This is because the UK's participation in the European Union (EU) before 2020, which empowers citizens across the EU to get work permission inside the EU. Thus, the expansion of the EU naturally influence the immigration to the UK. It is estimated that the expansion of the EU in 2004 results in an additional labour force of 5 million from new members of the EU, during 2004 to 2009 [394, 128]. Not only the population inflows from EU but also the ones from Asia that contribute a substantial accumulation of non-UK-born population in the UK. According to ONS [156], in mid-2020, there are respectively 9.2 million non-UK-born people of non-UK-born in the UK, for though both numbers have been slightly smaller than the previous year. The people born in India are the most common among non-UK-born groups, and then are the ones from Poland, Pakistan, Romania, and Republic of Ireland [156]. According to the Office for National Statistics, people from EU and Asia account for a major part of foreign-born employment in the contemporary UK.

UK has witnessed a consistently increasing flow of immigrants into the country. Most importantly, these migrants are from different countries, which translates to high ethnic diversity of the immigrants. It is much likely that migrants have a working capability, with regard to age, skills, amongst other factors. A majority of migrants over the past twenty years have come in for study or work. They could bring dependents, however, net immigration has resulted in an increase in labour force, a reduction in the dependency ratio, and an increased economy's output capacity [416]. The consequent inflow of individuals has increased aggregate demand, increasing the total spending with UK's economy. Together with increasing, labour supply, there has been a consequent increase in labour demand as a result of the increased spending in the economy [133]. Despite such positive influences, there is some debate that the UK is 'overcrowded' as a result of the rapid increase in population and consequent challenges such as housing shortages [133].

Overall, in line with George et al. [176], the immigration impact has majorly depended on the qualifications and skills of migrants, with the UK increasingly being strict on only accepting skilled workers. Age has also been a crucial factor of the UK labour market and the integration of immigrants. A high percentage of young workers are let in to assist in reducing the dependency ratio, which a crucial issue for the UK budget [176]. Also as pointed out by George et al. [176], the labour market and the integration of migrants into the UK hugely depends on the present economic climate. In an economic recession, migrants are less likely to gain employment in the UK. Finally, in line with George et al.

[176], the labour market and the integration of migrants hugely depend on the skills and types of migrants.

In summary, the UK has seen a steadily growing flow of immigrants into the country, with these migrants coming from different countries, which translates to a high ethnic diversity of immigrants. Moreover, the high proportion of immigrants in the UK are of working age. As a result, the UK is in a good position to investigate the problems of the integration of labour markets between different immigrant groups.

1.4 Integration of immigrants

This study uses a life course perspective to understand the integration of immigrants into the destination country throughout life. Two aspects of integration, such as the integration of the education system during childhood to adulthood and the integration of labour markets in later life, are taken into account.

1.4.1 Immigrants' education system integration and labour market integration

The IOM [154] estimated the number of immigrants globally at approximately 281 million people in 2020. Based on their analysis, the number equates to approximately 3.6% of the world's population. The number of immigrants globally increased by 3.2% from 2019 where the approximated number was 272 million. Europe and Asia are at the top of the hosting list, with 87 million and 86 million immigrants respectively; this makes up a total of 61% of the global immigrant population. North America comes in third, with an immigrant population of 59 million people, which equates to 21% of the global population. Africa, Latin America, and the Caribbean, and Oceania follow in the fourth, fifth, and sixth positions with nine, five, and three percent respectively.

The main individual determinant of the immigrants' educational outcome is their ability to adapt. Wiren [431] explains that this ability is defined based on their generation status. The first generation is students who immigrate to another country; the transformation process disorients the student and this is reflected in the short-term academic outcome. Wiren [431] explains that second-generation immigrant students perform better compared to the first generation. The other attribute is the student's family-specific factors such as the socio-economic status and cultural norms which might influence the student's attitude

towards learning. IOM [154] states that immigration in Eastern Asia consists mostly of the student movement.

Among the wider structural determinants are the host country's cultural norms and practices. Some of the host country's cultural practices might contradict an immigrant student's beliefs, for example in the case of a Muslim student. The students can also be affected by the host country's attitudes towards immigrants [410]. The new school structures also influence the student's adaptation and consequently the overall academic performance.

IOM [154] records that a greater percentage of immigrant workers tend to move into countries with better opportunities, stable economies, and evolved labour markets. Therefore, the main wider structural determinant of the immigrants' labour market outcomes is the country-specific labour market attributes such as wage rates and working conditions [59]. Regarding determinants, the personal skills and competency of immigrants significantly determine their labour market outcome. Their body composition is also an influencing factor, for example, a physically fit immigrant is more productive than a sick one or one with a disability when physical work such as building and construction are considered.

1.4.2 Education system integration of immigrants in Taiwan

The majority of marriage migrants marry Taiwanese men in the hopes of escaping poverty and unrest in their home countries, which are exacerbated by capitalist globalization. Since 1987, there have been 561,630 foreign spouses in Taiwan, largely from China and Southeast Asia. According to Taiwan's Ministry of Interior [331]; 92% of these foreign spouses are women.

Immigrant trend are different in Taiwan than other countries. The distinct immigrant trend appears in Taiwan- Since some Taiwanese males have not been able to find appropriate females to continue the next generation, they have turned to marrying females from foreign countries, especially from Southeast Asia or Mainland china [392]. Mostly males with lower socioeconomic status are marrying foreign brides. Migrants marry mostly farmers and men from the working class [224]. Most arrive knowing little or no Chinese or other Taiwanese languages, resulting in further isolation. Immigrant women of Taiwan are considered as a threat to population quality by the state and the public because they are suspected to be incapable mothers and unworthy citizens [268]. According to Taiwan's

Ministry of Education [330], the immigrants' children make up 21.13% of Taiwan's student population from grades one through nine.

Lin and Lu [282] conclude in their study attempt to establish the differential gap between students with native and immigrant mothers based on specific subjects, grades of lower-level institutions, and years of higher learning institutions. Based on their analysis, the researchers conclude that there are differences in the academic performance of students with native mothers and those with Chinese and Southeast Asia mothers. The researchers also discovered that academic differences between native students and those whose mothers are from Southeast Asia is broader, whereas students' performance is similar to native students suppose their mothers come from Mainland china, ascertaining that the immigrant mothers' language proficiency has a significant contribution on the students' learning.

Chang et al. [86] identify mental health as the major factor determining the performance of students with immigrant mothers in Taiwan. The researchers claim that these children have emotional and behavioral issues which are not witnessed in the children with native mothers. From their analysis, Chang et al. [86] establish that immigrant mothers' children have 'externalizing and internalizing problems'. The researchers explain that most of the externalizing issues relate to sociodemographic, family attributes, and parenting mechanisms. Immigrant parents are not actively involved in their children's education mostly due to language barriers or employment requirements [89]. Chang et al. [86] conclude that issues like family support and parenting techniques affect children regardless of their immigrant status. Therefore, improving these family-specific factors may lead to better performance; this explains why some children from immigrant families perform well.

1.4.3 Labour market integration of immigrants in the UK

UK hosted approximately 9.5 million immigrants which equal 14 percent of the population. Of the total number of immigrants in the UK, Indians made up 9.1%, ranking India as the top country of origin [145]. Poland and Pakistan follow at positions two and three with 8.6% and 5.8% respectively. The other countries, in their order on the list, include Romania, the Republic of Ireland, Germany, Bangladesh, South Africa, Italy, and China. As of September 2020, immigrant workers made up approximately 16% of the UK's workforce. Of the total immigrants, 84% and 67% of the men and women respectively, were employed in 2019.

Brynin and Güveli [63] advise against occupational segregation in their paper due to its

negative effects. The researchers also discuss that minorities, specifically immigrants and other ethnic groups, should not be overrepresented in terms of wage gaps as this introduces a 'protective' attribute to segregation. Heath and Cheung [204] support the discussions by Brynin and Güveli [63] in their paper on 'Ethnic Penalties in the labour Market.' The researchers establish that specific minority groups including Pakistani, Bangladesh, Black Caribbean, and African men suffer from high rates of unemployment. Those who are employed are also paid low wages compared to their white coworkers. Immigrant women also suffer from unemployment, however, those who are employed enjoy higher is not equal wage rates than white women.

Amo-Agyei [12] explains that currently, white immigrants from specific regions such as the US, Australia, and New Zealand enjoy higher wage rates compared to their coworkers from Eastern Europe. The IOM [154] indicates the migration in and out of Eastern Asia is significantly attributed to students' mobility and the largest proportion of Asians moving to the United States go through family-sponsored visas with the majority being students and highly skilled workers.

1.5 Dissertation structure

Figure 1.1 is the brief structure map of the dissertation. An understanding of the previous literature and background is critical to appreciate the directions of this research, so Chapter 2 begins by providing information on trends and reasons for changes in family structure as number of two-parent families decreasing while number of non-traditional families is increasing. Among these non-traditional families, immigrant families may include more than one culture within the family. Individuals in immigrant families may find themselves living with two identities or perceiving that one culture is better than the other. Hence, they are likely to have more barriers or challenges to adapt to and integrate with the culture of the destination country. Reflecting this phenomenon, we then put our focus on reviewing the literature on the immigrant families and identify major facets immigrant families facing in the extensive body of immigrants integration research. Two major facets such as education system integration and labour market integration are identified.

Building on the review of the previous chapter, this dissertation sought to fill the literature gaps by conducting three studies. Chapter 3 focuses on the effects of family structure on children's academic performance, using multi-wave survey data from Taiwan and a machine learning-based propensity score algorithm. This study aims to determine the

different relationship between children from different family structures (two-parent households, skipped-generation households, single-parent households and immigrant households) and their cognitive knowledge (measured by the test results).

Chapter 4 provides a comprehensive study of the impact of the immigrant mother's nationality on the academic performance of the children. Taiwan has a very unique immigration phenomenon, in which marriage is the main reason for most immigrants, and the number of immigrant women is much higher than that of men, so the number of immigrant families is growing. As a result, it is the most suitable country to assess immigrant family issues. Therefore, this study uses data from Taiwan to assess differences in test scores between children with immigrant mothers from different birth countries.

In terms of labour market integration, Chapter 5 evaluates the differences in the pace of labour market integration between immigrant groups. In the UK, there has been a steady increase in the flow of immigrants. Moreover, the UK is an ethnically diverse society. The growing trend of immigrants with ethnic diversity makes the UK a good case for exploring ethnic diversity and change. To this end, we use UK data to investigate differences in labour income and labour income growth between different immigrant groups. In addition, we will investigate whether differences in cognitive and non-cognitive skills between immigrant groups contribute to differences in the degree of integration into the UK labour market.

Chapter 6 summarises the main findings of the dissertation. The main conclusions are formulated in relation to the three aims of the study and the two areas of substantive knowledge and policy. In this chapter, the main limitations of the study are also discussed and potential avenues for future research on the integration of immigrants are proposed.

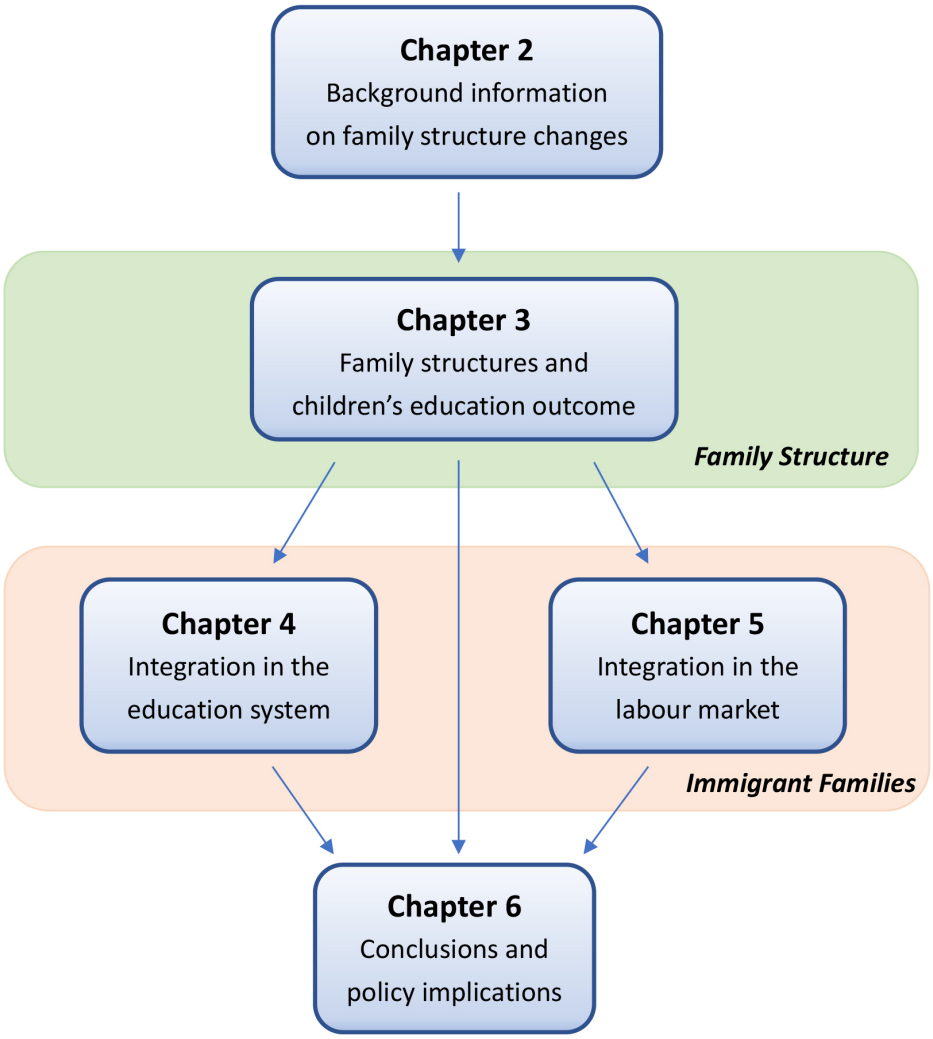


Figure 1.1: dissertation structure

Chapter 2

Literature Review

2.1 Introduction

Family structure has long been considered the key aspect of family background that can influence various developmental outcomes of children, including academic performance and achievement. One of the most common phenomena in literature that deals with the issue of differences in performance between children in non-traditional household structures and those in two-parent households is that they tend mainly to compare academic performance between children from a certain non-traditional household structure and those from families where both parents are present. However, the family structures have changed over the years, with non-traditional family structures emerging. Differences in resources or parenting between different family structures can affect children differently. As a result, the comparison of only children from two different family structures lacks completeness. The aim of this study is to contribute to filling these gaps by comparing the academic performance of children of four different family structures (i.e., two-parent households, single-parent households, skipped-generation households, immigrant households).

In addition, extensive research has been carried out to understand the experiences of immigrant families due to the increase in the number of immigrants and hence the growing trends in immigrant families. Substantial progress has been made in understanding the parental and personal factors that hinder the performance and development of their children and their educational outcomes. Especially in Taiwan cases, the research that examines the academic performance of immigrant children places a greater emphasis on children born to foreign mothers and native fathers, as this type of family is widespread

among immigrant families in Taiwan. Others focus on children born of foreign mothers and fathers. Their focus group always include a native or immigrant father as an influential figure [438, 165, 229]. As a result, it is difficult to say that the disadvantaged performance of children from immigrant families is due to the effects of immigrant mothers, not of immigrant fathers or native fathers. To this end, current research would stand out from other studies on immigrant families, as it will focus on the academic performance of children with immigrant single mothers.

Extensive research has been devoted to understanding the outcome of immigrants in the labour market. According to studies on the integration of labour markets, immigrants are characterised by lower participation rates in labour markets, higher unemployment, and differences in inclusion in the various fields of labour markets [353, 338, 415]. Factors such as language barriers, cultural and social barriers have been referred to as the common barriers in the process of labour integration for immigrants [221]. Increasing research on the topic points to the growing influence of cognitive abilities as the main concept in immigrant labour integration [386].[1] Clearly, the role of cognitive skills in influencing the pace of integration of migrants has been largely evaluated. However, based on the concept of Heckman et al. [210] on the formation of human capital, non-cognitive skills may be as important in the formation and development of the labour market integration as cognitive skills. There are limited studies that deal with the potential of non-cognitive skills in the process of integration into the labour market.[2] The present study seeks to contribute to filling these gaps by determining how differences in cognitive and non-cognitive skills contribute to differences in the pace of immigrant integration into the labour market.

2.1.1 Conceptual framework

The dissertation, as a whole, is framed and structured by a life course perspective. We focus on the cognitive development of children in different family structures and how cognitive and non-cognitive skills affect their success and integration into the labour market. A

[1] Cognitive skill is also referred to as cognitive ability or cognitive function, are abilities needed in acquisition of reasoning, manipulation of information, and manipulation of information. Several domains are contained in the idea of cognitive ability, e.g., perception, attention, memory, learning, decision making, and language ability [252].

[2] Non-cognitive skill is also known as personality traits, and psychologists have developed a series of tests to measure such skill (e.g., Sternberg [388]), among which the most well-known might be the Big Five personality traits. Big Five includes Openness to Experience, Conscientiousness, Extroversion, Agreeableness, and Neuroticism.

conceptual framework is shown in Figure 2.1.

The dissertation first examines how family structure influences the cognitive ability of children, which is evaluated by academic performance. Many different family structures, such as two-parent families, single-parent families, skipped-generation families and immigrant families, are included in this dissertation. Immigrant families differ from other family structures, as members in immigrant families must face a dual culture. Children and parents in immigrant families should have to undergo acculturation. While they are acculturating, they are likely to face some challenges. The challenges are divided into two types, such as individual challenges and structural challenges. Therefore, the dissertation emphasised the evaluation of the integration of immigrants into the destination country. The dissertation uses the perspective of life to investigate the integration of immigrants into the education system and the labour market. From a life course perspective, entering school (education) and entering the labour market are the two important events in life.

This chapter seeks to (1) review the literature on the changing trends in family structures, (2) review the literature on the individual barriers and structural challenges faced by immigrant families in order to identify gaps in knowledge and (3) identify the two key issues faced by immigrant families and provide a comprehensive literature review on it. The chapter is structured as follows. Drawing on the review of previous studies, Section 2.2 provides knowledge about the growth of non-traditional household structures. Section 2.3 reviews studies to understand the individual barriers and structural challenges of immigrant families. Then, attention is focused in two key issues which are faced by immigrant families: (1) integration of the education system and (2) integration of the labour market. Deficiencies and knowledge gaps will be addressed in Section 2.4. The aims of the current study, as reported in the introduction, are re-stated in section 2.5.

2.2 Changing family structure

In the last 40 years, major social and demographic trends have transformed the basic structure of households in developed countries [312, 430, 417]. The family structure has experienced significant changes worldwide, with the most notable change being the deviation from the traditional two-parent family structure to an increase in single-parent households, skipped-generation households and immigrant households [91]. Mackay [293] documents an accumulation of evidence that children raised in different family contexts exhibit different patterns of results in a wide range of developmental areas. The impact

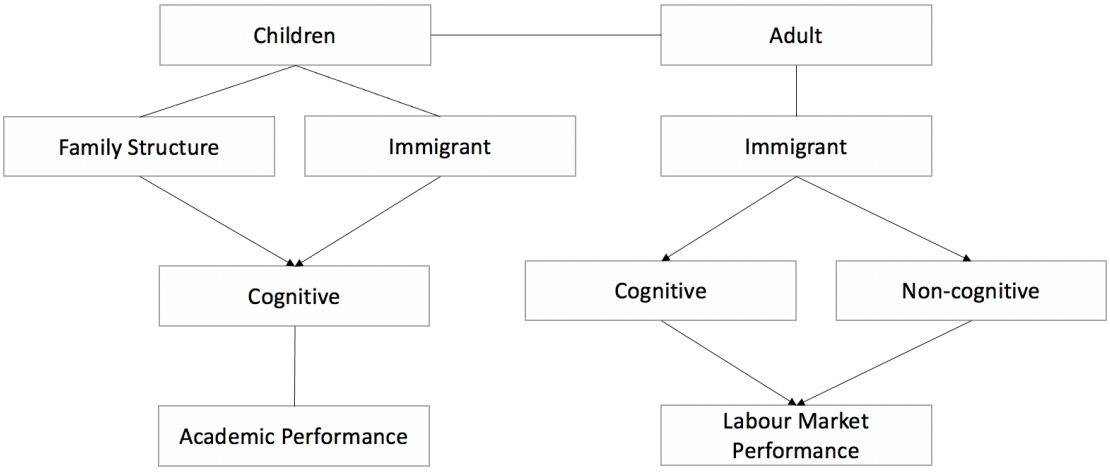


Figure 2.1: Conceptual framework

of family structure on children's educational outcomes is well documented in previous studies [5, 237]. Children from two-parent families perform better than children from single-parent families [300, 178]. Moreover, Monserud and Elder [309] used data from the National Longitudinal Study of Adolescent Health in the United States, which found a persistent disadvantage relationship between skipped-generation families in terms of child educational attainment. Moreover, Kelch-Oliver [249] found that African-American grandchildren from skipped-generation families face challenges at school, such as low academic performance.

In addition to below-replacement fertility, population ageing, rising average rate of divorce and increased participation of women in the labour force [321], international migration has become key drivers of national population change [322]. Over the past few decades, international migration has increased tremendously. IOM [154] attributes reasons such as easier travel, more access to information regarding distance and places, friends and relatives who have migrated, and the opportunities for improving living standards to the increased immigration of individuals. The present world estimate is that, in 2019, there were close to 272 million global migrants in the globe, translating to close to 3.5% of the world population [154]. This was 119 million more than the 153 million immigrants

as of 1990 and three times more than the 84 million immigrants as of 1970 [154]. Such figures represent one obvious trend: the number of immigrants will continue increasing going into the future [154]. Such an increase has had a significant impact on population change, which is majorly influenced by immigrant households and related dynamics such as intermarriages when immigrants get to the host country [50, 390]. Therefore, number of immigrant families is increasing.

2.3 Challenges of immigrant families

Immigrants and their families face a number of challenges and barriers. Overall, these challenges may be classified as individual or structural challenges [343]. The individual challenges include family or group challenges. The structural challenges relate to political, economic, or social environment, for example, unemployment and population pressures, and policy structures [343]. Some of the individual challenges immigrants together with their families experience include losing support from members of their extended families, losing familiar values, stress as a result of possible exposure to various traumas, and the lack of language proficiency [352]. Also, a different individual challenge is the reality of being separated from family and friends that sets in while immigrants live in a strange environment [352].

Regarding structural challenges, when immigrants get to the host nation, they undergo a number of stressful experiences, for example, multiple geographic dislocations and moves in search for employment opportunities and better livelihood, new economic pressures from consumer economies, stressful legal proceedings, which is also common amongst immigrants who are documented, all while trying to teach themselves a different language, adopt to a new culture, customs, educational and legal systems [352]. For undocumented immigrants and families, there is a high likelihood of being stressed by the traumatic experiences they undergo in the hands of immigration authorities [352]. Immigrants also have to deal with other structural challenges like discrimination (xenophobia, which may be in form of racism), domestic and community violence, and the challenge of social and economic margination [352].

2.3.1 Individual challenges

Migrants face a lot of challenges in the host nations, but these may be best characterised by experiences in education and then in the labour market. To begin with, they may face difficulties learning and speaking the languages of the host nation - this can introduce barriers to activities such as job seeking and making friends [8]. Also, immigrants may face difficulties accomplishing primary tasks like filling forms and buying food. One of the biggest challenges immigrant parents face is raising their children in a new and unfamiliar culture. Yet second generation immigrants may integrate more easily compared to first generation immigrants where, for example, immigrant children can pick up the English language quicker than their parents [8]. This affects the relationship between parents and children. Regarding school, parents could feel disappointed with seeing their children struggle to keep up in school, and a majority of parents have reported bullying and discrimination cases due to cultural differences. Parents may also not have the language skills and the education to assist their children, and thus make it hard for them to communicate with the respective learning institutions to address the challenge [8].

Whereas migrants may be happy to take any available job when they first get to the host country, finding and progressing in a job is extremely challenging [8]. Migrants who are educated and who initially had strong jobs in their country of origin are often underemployed in the destination country [8]. Moreover, migrants may be considered as possible targets for exploitation and discrimination in the workplace [8]. Certain employers recognise the sense of desperation and urgency amongst such groups to secure their jobs, so they will have immigrants take dangerous and less desirable roles [8]. Undocumented immigrants, specifically, assume that they have no rights, and employees who cannot speak English are easily targeted.

In sum, the two main issues for immigrant families are education integration and labour market integration. Section 2.3.1 identifies the immigrant-native performance gap in terms of education outcomes. Section 2.3.2 reviews studies on the labour market integration and points out the different labour market outcome between immigrants and natives.

2.3.2 Structural challenges

Immigration is also primarily driven by structural factors like demand in the labour market (economic), wealth inequalities between poor and rich countries (economic), development and conflicts in the country of origin (political), the challenge of having to adapt to a new culture (cultural), alongside self-sustaining internal migration dynamics [153].

When immigrants get to the host nation, they experience a number of structural challenges, for example, multiple geographic dislocations and moves in pursuit of better livelihood and economic opportunities, economic pressures from consumer economies, and lengthy and sophisticated legal procedures, which is also common for documented immigrants, all while trying to adopt to new culture, customs, educational and legal systems [352]. Overall, structural differences, such as the quality of education system, between the host and home countries may also be significant challenges which affect immigrant integration.

Immigration policies vary from country to country, and this determines the magnitude of structural challenges immigrants face [352]. In specific countries, for example, the U.S, there are specific immigrant integration policies, such as the 1990 Immigration Act, which help immigrants to integrate easily [148]. Other countries such as the UK have no specific immigration integration policies. Immigration policies have also led to the challenge of undocumented immigrants, who are more likely to be stressed by immigration authorities [352].

The long-term structural challenges immigrants face include the challenge of economic and social margination, domestic and community violence, discrimination, and economic stressors [352]. Other traumas and stressors have notable adverse psychological impact, on immigrants' children. The impact may cut across generations, with consistent effects on adaptation, acculturation, and integration. The primary long-term challenge for immigrants and their families are those coming from xenophobia in the host nation [352]. In line with Pumariega and Rothe [352], xenophobia is negative prejudice directed against an ethnic or national group, which commonly shows itself via overt to subtle discrimination and economic and social margination. Racism may be also be a xenophobia component, based on the racial differences witnessed amongst immigrant groups, which may be classified as immigrant other whites, immigrant Asian, immigrant black, and immigrant mixed.

Also, in line with Pumariega and Rothe [352], xenophobic attitudes may also be attributed to the widely spread view around the importance of immigrant assimilation. Specifically, critics expect immigrants to use English whenever they want to communicate and avoid using any interpreter or translation services as they receive public services. Terrorism fear in the present environment is another conventional structural challenge.

The more extreme xenophobia forms are related with anti-migrant movement, which according to Pumariega and Rothe [352], has led to the controversy surrounding undocumented immigration and the formulation of anti-immigration militia groups. In countries

such as the U.S, the government put in place military-style immigration enforcement raids in schools, homes, and workplaces, which led to thousands of undocumented immigrants being arrested, detained, and taken back to their native countries [352]. Immigrants' children and other dependent members of their families could be left in isolation in their communities and homes with no support means. Such structural challenges have essentially affected immigrants' children, commonly leading to posttraumatic stress disorder (PTSD) and acute stress reactions [87, 76].

2.4 Immigrants' integration in the destination country

Integration is a term used for describing the changes that immigrants, their families, and children, and the community they have become part of, undergo in responding to migration [68]. Integration is defined by Bean et al. [34] as the procedure by which members of host communities and nations and immigrant groups resemble each other. This process, with both sociocultural and economic dimensions, starts with the first generation of immigrants and goes on to the second generation and past that [34]. Immigrants undergo a number of challenges, and such challenges result in various integration levels in the host nation [68]. In addition, the integration process is based on the involvement of immigrants and their children in social systems like learning institutions and the labour market, together with them being social accepted by citizens of the host nation [7].

The body of literature on immigrant integration has commonly discussed the various aspects of integration separately. For instance, De Paola and Brunello [118], evaluated the integration of immigrants into the educational system of the host nation. They found that in a number of countries, there are several education gaps between native individuals and second generation immigrants. They also establish that second generation immigrants on average have lower math and reading test scores than the children of the native parents [118].

On the other hand, Fernandez Macias and Paniagua [144] assessed the integration of immigrants and their children into the labour markets of European countries. Their body of research did this by taking into account the big diversity of the population of immigrants and their children, and analysing their labour market integration in Europe. Their body of research pays attention to not only employment and participation, but also the quality of the jobs immigrants have taken, and the match between such jobs and their level of education. Fernandez Macias and Paniagua [144] establish that the integration of immigrants

into the labour market is significantly low in a majority of European nations, which is evidenced by unequal job opportunities and decreased work performance for immigrants who have secured jobs as compared to natives. Fernandez Macias and Paniagua [144] support a wide body of research on labour market integration of immigrants [17, 266, 60].

Notwithstanding, our study is different from the past. The current study uses the perspective of life course to investigate the integration of immigrants in education system and labour market. According to life course perspective, entering school (education) and entering in the labour market are the two important events in one's life. As cited by Jacob and Weiss [236], education carries profound social consequences for life's later opportunities. Overall, together with the inherent interest they have for diversified and individualised pathways between work and school, such patterns have a close correlation to various life domains and affect the life course in areas that interest sociologists [236]. In other words, the life-course perspective is the correlation between entry to the labour market and educational participation [236]. Up until this study, no study has incorporated the life course perspective, and this points out a clear gap of research. In this line, this study examines immigrant integration from the life course perspective.

2.4.1 Education system integration

In the present century, global and national research entities have continuously become cognizant of an 'integration challenge' of migrants in the educational systems of European communities. Research by Heckmann [211] points out preschool enrolment has improved in a majority of nations, however, migrant children in specific nations such as Germany, continue to enroll at relatively older ages compared to native children [211]. There also seems to be no evidence that the enrolment of migrant children in primary education institutions is less compared to natives'. However, in line with Heckmann [211], the comparability of enrolment data from EU nations is low. Secondary school enrolment of migrant students is common in institutions that are of shorter duration and academically less demanding [211]. The research also established that migrant children commonly remain for a reduced duration in secondary education. Another crucial element of institution enrolment is that migrant children are overly represented in special education institutions [211].

Indicators and achievement tests of students point out when primary school education ends, immigrant children achieve significantly lower in comparison to native students [211]. Consequently, immigrant children are very much likely to be chosen for the aca-

demically less challenging secondary tasks in systems where the selection happens when primary education ends [211]. As cited by Heckmann [211], the OECD PISA research on conventional academic skills, including science and mathematical literacies and reading, reveal significant disadvantages for immigrants, despite the differences being substantially large in various countries. Amongst immigrants, achievement scores with regard to gender reveal consistently that boys score lower compared to girls [211]. In all ethnic groups, girls with a minority or migration background portray a better performance compared to boys, specifically at the secondary and primary level [211].

There is a significant exception from the overall theme of underachieving and disadvantaged youth with a background of immigration: Indians and Asian groups in the UK, and the youth in Germany with a Jewish Soviet union offer a good illustration of where some migrant groups perform relatively better than their native peers [211]. In the UK, for example, students of Indian and Chinese background perform better, whereas those of Caribbean origin are more likely to perform worse than the White British born population [211]. Such differences between different groups relative to the native born majority population relate to a number of factors, including differences in socio-economic status and integration policies that could support the settlement of migrant groups in host communities and societies. Research suggests that for many countries, both the first generation and second generation migrant students tend to perform worse compared to native students [344]. This is true for countries such as Sweden, France, Slovenia, Austria, Germany, Netherlands, Denmark, Italy, Norway, Belgium, Spain [344]. Indeed Lin and Lu [282] note a similar trend in Taiwan. Across OECD nations, in science, for example, the average performance of first generation immigrant students was 447 score points, close to a half a standard deviation below the average performance of native students. Second generation immigrant students an average score of 469 points [344].

The academic performance gaps between immigrants and natives are attributable to a number of reasons. In line with Brell et al. [60], both individual and structural characteristics influence the integration of immigrants into the education system of the host nation. Individual characteristics such as language proficiency influence the integration of immigrants into the education systems of the host nation [235]. Language, in line with Cerna [83], is one factor that may hinder or promote the integration of immigrants into the education system of the host nation. Language skills are not only critical for academic performance, but also crucial if immigrant learners are to have a sense of belonging to a learning institution [83].

Besides, in line with Eurydice [140], mother tongue proficiency is another individual characteristic influencing the integration of immigrants into education systems. As mentioned by Eurydice [140], mother tongue competencies are helpful in assisting immigrant learners to learn the instruction language and speed up their development in every area. A wide body of research has also pointed out that mother tongue competencies enhance second language competency and increase cognitive development [67, 40, 29].

In line with Cerna [83], another individual characteristic is mental and physical health. Immigrants and their children may portray poor physical health as a result of a change of environment and exposure to life-threatening conditions [432]. In line with Fazel and Betancourt [143], two factors are critical in understanding the factors that determine immigrants' mental health: the fact that they have been exposed to past and current stressors and ongoing traumatic events, and the dynamics that surround the post-migration environment, for example, having to deal with a reconfigured family life and support, discrimination, and dealing with school. Past exposure to possibly traumatic experiences alongside interaction with a new environment may decrease or worsen the risk of PTSD [414]. Such stressors and traumatic events will highly affect the learning experience of immigrant learners, limiting their ability to concentrate, amongst other related effects such as decreased academic performance, and thus poor integration into the education system of the host country [398, 49].

In line with Lemu [274], good performance in school directly correlates to the assistance parents provide to children, and academic assistance is something some immigrant parents may face difficulties in providing [274]. The barriers some immigrant parents may face to helping their children in academic success is also supported by other social science theorists such as Fuligni [171]. Some of the factors identified include low English language skills, the nature of experience of settlement of the migrant families into the host communities, arrival from war-inflicted countries with limited resources, and a lack of knowledge as to how to navigate the education systems of host nations. Immigrant parents have limited access to economic and social capital compared to native born parents, which affects children in the way parents within immigrant families are able to support their children differently [274]. In line with Lemu [274], parents are the foremost and most influential individuals for their children before joining schools. However, inaccessibility to resources and a the potential negative initial social environment migrant families encounter may undermine the ability of migrant parents to provide such support to migrant children [274].

Regarding structural characteristics, as mentioned by Cerna [83], a number of politi-

cal, economic, and cultural factors influence the integration of immigrants into education systems. Political factors constitute school-level factors such as the learning environment, interactions between teachers and students, school engagement, and parental involvement [83]. The learning environment has an important role in integrating immigrant students, in the sense that an inclusive one offers a curriculum that caters to the diversity of students to ensure that all learners have a sense of belonging [401]. Besides, immigrant youths are over represented in vocational institutions [211]. This is important as the social and economic composition of the student population may matter for educational attainment and academic performance. Where children of migrant families concentrate in particular types of institutions, such as vocational institutions, this type of educational segregation may contribute to differences in educational outcomes. Many children from migrant families are in institutions where migrant children constitute the majority of the institution's population. As peers play a critical role in socialisation and school achievement, school segregation can then also hinders integration and school achievement [211]. School leaders and the policies they implement are critical in integrating immigrant learners [382]. They are particularly handy in promoting positive images of immigrant learners in schools, and thus promoting their integration. As set out by OECD [150], teachers are commonly not prepared enough in pedagogical approaches for second language learning and in assisting learners to cope with the trauma that a number of immigrant children have to deal with. Cerna [83] sets out that socio-cultural factors such as sports also influence the integration of immigrants into education systems of the host environments. Sports provide equal opportunities and ensure racial equity amongst those taking part in such activities, giving room for immigrants to preserve their cultural identity as they integrate into the host community. By taking part in sports with native individuals, immigrants learn about local culture and customs, interact with their peers, and in the process, develop language proficiency, which ultimately helps to integrate them into the education system of the host nation [295]. In line with Dykes and Oliff [134], sports offers a sense of direction and purpose for immigrants recovering from different traumatic experiences or racism incidences.

Immigrants from different backgrounds are also subject to different education system integration. Immigrant students (learners with an immigrant background) or minority students are disadvantaged with regard with enrolment in type of institution, duration of attending school, academic achievement or performance, rate of dropout, and educational level, all of which are indicators of integration into the education system of the host country. In light with Noorani et al. [329], the level of educational integration varies across

immigrants as a result of the diversity of the challenges they experience, both in the home country and the destination country. Hamilton [195] identifies one group of challenges as those relating to the process of immigration, and the impact it has on the overall well-being of the immigrant student. In line with Sinkkonen and Kyttälä [383], political and socio-economic issues, for example, the policies impacting the availability of resources to learning institutions in the host country to promote integration, together with the policies that promote equality and inclusion, vary from one country to another, which in turn leads to a varying levels of educational integration. Researchers such as Trasberg and Kond [405], Nilsson and Axelsson [328], and Hamilton [195], draw on challenges relating to learner participation in education, which include language provision in host countries which is not modified to the needs of immigrant students, inadequate learning support, lack of emotional and social supports, ineffective school-home cooperation, and inappropriate grade placement. All of these factors vary from one host country to another, thus, the varying levels of integration across host nations [329].

2.4.2 Labour market integration

The integration of immigrants into the market is also dependent on individual and structural characteristics. Regarding individual characteristics, Anger and Heineck [14], draw on the relationship between cognitive ability of immigrants and their success in the labour market. They establish that employment relationships of immigrants are built on the combination of immigrants' education and their ability to use past experience and the knowledge they have gathered to solve particular tasks. Anger and Heineck [14] stress that educational training and cognitive abilities are critical to labour market integration, which aligns with the body of research on the same [210, 285, 334].

Language proficiency is also identified as a cognitive ability [235], which is essentially an individual characteristic. The significance of language proficiency for effective labour market integration, in line with Isphording [235], comes from at least two clear roles of language skills: the fact that language is the primary communication medium, and the fact that language skills complement the education and experienced gained before immigration and facilitate the transfer of skills into the new job [235]. Moreover, as a set out by Isphording [235], low language proficiency is commonly highlighted as contributor to failed labour market integration, and may inspire anti-immigration attitudes and policies. Also, as cited by Fernandez Macias and Paniagua [144], proficiency in the main language of the

host nation has been established as a primary decider of both employment and earnings. This is not new, based on the significance of communication skills in the current economies that have continuously shifted to being knowledge and service based. In the UK, for example, Dustmann and Fabbri [132] report that fluency in the English language improves employment probabilities by over 20% and boosts earnings by more than 20%. Leslie and Lindley [276] establish that poor English language skills contribute significantly to high unemployment rates and result in reduced economic activity rates.

According to Fernandez Macias and Paniagua [144], an research on the labour market performance of migrants which was conducted by Chiswick [95] was founded on the hypodissertation that migrants have low initial earnings as a result of their decreased productivity levels due to their comparative lack of nation country-specific skills when they get to the host nations [144]. This may include a lack of knowledge on the customs of the host nation, insufficient data about the existing job opportunities and inadequate training [144]. However, Chiswick [95] then argues that the later earnings of the migrants can exceed those of native-born peers through the favourable selectivity of immigrants as they will develop and nurture nation-specific skills. Reporting on existing empirical research, Chiswick [95] identified that the wages of white immigrants were same as those of natives, while those of non-white migrants were around 25% less, with no likelihood of increasing with time. This was also in line with research by Bell [39], who used UK data over a lengthened period and established that recent white migrants earn more than UK natives, while non-whites earn significantly less then UK natives in the period immediately after migration.

With regard to structural factors, Deakin [119] draws on the dual labour market theory, which identifies a division of the market as a primary segment that comprises of stable employment in organization specific-labour markets, and another secondary segment of short-term, unskilled, and low-paid jobs [188]. This is the case in the immigration context, where immigrants get the secondary segment jobs whereas natives easily qualify for primary segment employment. Employment within the vertically-integrated companies is founded on official and bureaucratic procedures and rules, whereas work in the secondary market is governed by uninhibited competition [119]. The dual labour market theory is compatible with the human capital theory, which asserts that long-term employment relationships and seniority-based remunerations would be identified in situations where organizations and employees invested in organization specific training [119].

Also, within the context of the structural factors influencing labour market integration,

the patriarchal structure of society plays a critical role. Particularly in their countries of origin, it is broadly recognised that female children in such patriarchal societies tend to get less attention and resources compared to male children [336]. Girls tend to be less educated compared to boys in most developing countries, from which thousands of migrate from. Thus when they get to host nations, the disadvantages they accumulated in the native countries lessen the chances for females to become employable, unless they increase their educational attainment. Consequently, this results in the poor integration of women into the labour market of the host nation as a result of the patriarchal societies they originate from [336]. Unless they improve their educational attainment, they miss out on the opportunities for decent and productive employment [336].

In addition, as set out by Adda et al. [2], variations in the patterns of labour market integration may be attributed to institutional contexts. Adda et al. [2] argue that the presence of restrictive immigration policies, or those that result in an uncertainty element, have a direct impact on lowering investment in human capital by the immigrants in the host nation. Consequently, they shorten their duration of stay and the investment in the acquisition of productive and technical skills [2]. Previous research has also been founded on the 'ethnic penalties' theory, which sets out that ethnic minority groups (immigrants in this case) realise poor labour market outcomes not only as a result of observable socioeconomic or demographic attributes, but also racial/ethnic attributes that set up societal barriers over their integration into the labour market [205, 373]. Ethnic penalties, in the context of the labour market, entail the procedures by which organizations hire or promote job candidates, which not only depends on human capital or labour market skills, but also influence by other racial, religious, and ethnic attributes [203].

Furthermore, the degree to which the current levels of education, training and experience of immigrants are treated with importance in the host nationis is also a primary factor influencing the performance of immigrants in the labour market. In line with Friedberg [161], human capital is imperfectly portable across nations. Together with variations in educational system quality between nations, the educational experience in the home country may not conform to the needs and expectations of employers in the host nation. Using data from Israel, Friedberg [161] established that the national origin of an immigrant, their experience and education, influence the degree the immigrants' human capital is treated with significance, and thus, is a critical determinant of what they will earn. Specifically, it is established that after immigration, migrants earn close to a quarter less than comparable natives based on their levels of skills [99].

Friedberg [161] also established that migrants have higher educational returns if they had obtained additional human capital in the host nation. Notwithstanding, differences are identified in line with what region the human capital was obtained from, with increased returns to education for Western and European migrants compared to African and Asian immigrants. Since there is a high likelihood that Western and European immigrants will come from nations with the same educational systems and economy to Israel, this pattern aligns with the concept that the differential returns to education points out the variations in school quality by the place or origin and the imperfect alignment of abroad education with the needs of the host nation's labour market [99].

2.5 Deficiencies and knowledge gaps

In summary, the above review of contemporary studies on the performance of children growing in different family structures reflects a fragmented literature that focuses largely on comparing academic performance between children from a particular non-traditional household structure and those from families in which both parents are present. Little attention has been paid to comparisons of the association between the academic performance of children in various forms of family structures.

According to estimates by the World Economic Forum, at least 3.5% of the world's population, which makes up 272 million people, migrates from one destination to another internationally by 2020. The ever-growing number of immigrants has led to an increasing number of immigrant family structures. More and more studies on immigrant families focus largely on the barriers they face in their destination country, the factors that affect their performance, and the integration of immigrants in the destination country. In terms of the integration of immigrants, literature on the integration of immigrants often discussed the various aspects of integration separately. Some discuss the integration of the education system, while others emphasis their labour market integration.

This dissertation, however, is different from the past. The need to study lifelong changes in the integration of immigrants has led to the application of a life course perspective in this dissertation. Various aspects of the life course of the immigrant are addressed and included in the dissertation. We discuss their academic performance of secondary school and the labour market performance, which represents their later life success. From the perspective of life course, the cumulative effects of the life event of immigrants along the developmental trajectory, with early advantages or disadvantages that lead a person to later life success,

are investigated. In other words, the benefits or disadvantages immigrants had throughout their life are discussed.

With regard to integration in the education system, academic performance is mainly used to capture it. Regarding the gap in education between immigrants and natives, they focused mainly on comparing children from immigrant families with children from two-parent families. The results show mainly that children from immigrant families are likely to perform poorly compared to children from two-parent families. Researchers attribute this phenomenon to the disadvantageous effects of foreign parent on children. The negative effect, however, may not be due to the immigrant parent, but to the other native parent. As a result, there is a lack of any sense of whether the immigrant parent will have a direct negative impact on his or her children. To this end, in this study, we compare the academic performance of children with that of a single immigrant mother to assess whether the negative impact on children's performance is mainly due to immigrant parents.

As for the results of the differences in labour market outcomes between immigrants and natives, the focus was more on discussing factors that influence labour integration. Factors such as language barriers, cultural and social barriers have been referred to as common barriers in the process of integrating immigrants into the labour market. Increasing research on this subject points to the growing influence of cognitive skills as the main concept in the integration of immigrants into the labour market. The role of cognitive skills in influencing the pace of migration integration has been largely evaluated, while there is a significant literature gap in the study of how non-cognitive skills influence labour market integration.

This dissertation aims to remedy these deficiencies on two main issues facing immigrant families, first by analysing the problem of educational integration of immigrant families from a broader perspective, taking into account children within all non-traditional family structures, knowing that children in immigrant families are more disadvantaged or not, and their associations with the country of birth of their mother. Taiwan dataset is used to analyse these issues. Due to the peculiar immigration trend in Taiwan, where more female immigrants than male immigrants, these female immigrants mainly immigrated from Mainland china and Southeast Asia to Taiwan. As a result, the number of children with immigrant mothers is rising. Furthermore, in Taiwanese culture, most men marry foreign brides are those with lower socio-economic status or lower academic qualifications. This can lead to a high probability of financial problems in immigrant families and thus to an impact on children's learning. Taiwan is therefore a suitable environment for analysing children's academic performance in immigrant families.

Second, this dissertation also aims to analyse the integration of immigrants into the labour market. The way in which differences in cognitive and non-cognitive skills contribute to differences in the pace of integration of immigrants into the labour market is also addressed. The different effects of cognitive and non-cognitive skills on different ethnic groups of immigrants are also investigated. As the United Kingdom is an ethnically diverse society, the United Kingdom provides an appropriate environment to investigate ethnicity and immigration issues.

2.6 Dissertation aims

To address the above deficiencies, the dissertation pursues three specific aims:

1. To establish the relationship between various forms of non-traditional household structures and children educational outcomes.

2. To determine extent and association of immigrant mother's nationality and their children's academic performance.

3. To examine the difference in the pace of integration amongst immigrant groups and the ways in which variances in cognitive and non-cognitive skills contribute to differences in the pace of migrant integration into the labour market.

Chapter 3

Estimating the Causal Impact of Non-traditional Household Structures on Children Educational Performance Using a Machine Learning Propensity Score

Abstract

The dissertation is formed and structured from a life course perspective. Besides, both children's cognitive development and their later success in the labour market are included and focused through the dissertation. In Chapter 3, the relatively early stages of life are being focused. The aim of Chapter 3 is to assess the relationship between different forms of family structures and the cognitive development of children in secondary school.

Over the last two decades, family structures have diversified. International migration has led to a rise in the number of families in which at least one parent is foreign-born. Increases have been observed in both the rate of partnership separation, leading to a greater number of single-parent households, and families in which grandparents have assumed caring responsibilities for their grandchildren. Existing evidence indicates a strong relationship between family structure and children educational outcomes. Parental involvement is well documented to be a key ingredient for the educational success of children. Drawing on Taiwanese multi-wave survey data (Taiwan Assessment of Student Achievement) and a machine learning-based propensity score algorithm for multiple treatments, this paper aims to determine the various relationship between children from different household structures (two-parent households, skipped-generation households, single-parent households, and immigrant households) and their cognitive knowledge (measured by test scores). Key findings reveal that children from skipped-generation families achieve the lowest performance scores, and that those with from immigrant background tend to perform even better than children from traditional two-parent households. Our results suggest that policy interventions targeted at providing remedial education and/or financial assistance are needed to support children from skipped-generation families to redress existing educational disadvantages in Taiwan.

3.1 Introduction

Key social and demographic trends have transformed the basic structure of households in industrialised countries over the last 40 years [312, 430, 417]. In addition to below-replacement fertility, international migration and population ageing have become key drivers of national population change [322]. Among these factors, international migration would lead to further changes in the composition of family structures in a country. Foreign migration into a country leads to more cross-border marriages, which increases the number of immigrant families.[1] Moreover, there are several factors that lead to changes in the family structure, such as the rising average rate of divorce and increased female labour force participation. As more women divorce from marriage, which reduces the number of two-parent families and increases the number of single-parent families.[2] Also, the disruption of marriage could leave grandparents' full responsibility for raising children, so there could be a higher proportion of skipped-generation family.[3] As a result, the *traditional nuclear household* has become less pervasive, with the global average share of nuclear households decreasing from 52.3% in 1990 to 43.2% in 2013 [323].[4]

These changes away from traditional nuclear family structures may have major implications for children cognitive development. In nuclear family structures, parents are typically the main responsible for their children developmental growth at home, and there is well-established evidence in development psychology and neuroscience that parents play a pivotal role in shaping the way their children perceive and process information, and behave in relation to external stimuli [139, 258]. Evidence shows how effort and perseverance attitudes from parents are adopted by children and translated into long-term cognitive development [275]; how adults influence children's emotional reactions [433]; how parents' usage of a wide and diverse vocabulary improve their children's literacy and cognitive competences [426, 313]; and, how the frequency and use of numbers at home lead to improved children's mathematical performance [48] – all competencies which are interconnected and contribute to facilitate learning at later ages.

At the same time, previous research has shown that children raised in non-traditional

[1] Immigrant households are comprised of families in which one or both of the parents are overseas born.

[2] Single-parent households are comprised of one single parent and their biological, step, and adopted/foster children) irrespective of children's ages.

[3] As defined by the United Nations, skipped-generation households consist of grandparents and their grandchildren, but none of the parents of the grandchildren.

[4] The traditional nuclear household indicates a family comprised of a married or in-partnership couple and their biological, step, and adopted/foster children) irrespective of children's ages.

family structures tend to experience social, cultural and economic struggles. These studies tend to focus on single family structures. Single parents usually face financial stress, have limited resources and tend to depend on external childcare [182, 131, 57]. Grandparent carers tend to rely on a limited pension, are usually unaware of contemporary generational trends, and are often less educated than their children [244, 27]. In immigrant family settings, cultural and language differences exist, and they limit or delay children' speech and language learning [380]. Thus, existing evidence suggests economic, social and cultural constraints are likely to undermine the cognitive development of children from non-traditional family structures. Yet, comparisons for the association between various forms of non-traditional family structures and children academic performance remains under-explored. Understanding this relationship is key to inform effective policy interventions targeted at improving children educational outcomes by providing appropriate financial assistance to less advantaged households.

To address this gap, this paper aims to establish the relationship between various forms of non-traditional household structures and children educational outcomes. Drawing on data from the Taiwan Assessment of Student Achievement (TASA), we evaluate the causal effect of different family structures on children's school overall grades by using Propensity Score Matching (PSM). Generally, standard regression approaches are used to evaluate the relationship between particular pairs of family structures and children's school performance. Yet, such approaches do not control for the influence of confounding factors on children educational performance and family structures. Family structures may differ in systematic ways leading to differences in children school performance. Experimental or quasi-experimental study designs are needed to adjust for these systematic differences [413]. We use PSM to estimate the causal effect of family structures on children's school overall grades, minimising the influence potential biases due to systematic differences across family structures. This ensures more robust comparisons based on students with similar observable characteristics across family structures. Specifically, we use students from traditional two-parent families as the control group and non-traditional family structures (i.e., skipped-generation households, single-parent households, and immigrant households) as 'treatment' categories in our analysis. We use multiple treatment PSM [298] to account for the multi-categorical nature of our variable identifying different family structures.

In Taiwan, the number of non-traditional household structures (i.e., single-parent households, skipped-generation households, immigrant households) have risen over the last 20 years. From 2001 to 2018, the number of single-parent and skipped-generation house-

holds increased from 520k and 75k to over 830k and 114k households, respectively (Gender Equality Committee, Executive Yuan). Reflecting an increased in the size of the foreign-born population, the percentage of children from immigrant households in junior school is estimated to have increased from 0.36% in 2003 to 11.04% in 2018 (Ministry of Education). While this reveals the rising importance of non-traditional family arrangements in Taiwan's demographic structure, the societal implications of this change remain poorly understood. Our work contributes to advance our understanding of how these new family structures impact children educational performance.

The remainder of this study is organised as follows. The following section reviews the literature on family factors and highlights discussion on the impacts of these factors on children's academic performance. Section 3.3 introduces the data set. Section 3.4 introduce the estimation strategy, while the description of the data and the empirical results are presented and discussed in Section 3.5. Section 3.6 provides the conclusion and the implications of this study.

3.2 Theoretical arguments

There are several theories about how the family influences children's academic performance. Firstly, socialisation theory. Socialisation theory perceives the attainment of education as a consequence of the ability of parents to give children the motivation and skills they need. Family disruption or non-marriage weakens the parent-child relationship, role modeling and internalization of parental values [216]. Children living with only one parent are subjected to a different hierarchy than children in two-parent households. They may receive less direct supervision, which undermines parental control and handicaps their ability to function in institutions that are fundamentally hierarchical, such as education [11, 105, 400].

Second, economic theory [1] and the Input-Environment-Output Model (I-E-O) proposed by Astin [18] illustrate the learning outcomes of children through a specific period of education of the input and environment encountered by the individual.

Economists argue that children's educational attainment is the result of an investment made by parents [201, 434]. Family resources are thought to systematically vary according to family structure [342, 36]. Proponents of this perspective argue that within the framework of household production, the child's educational attainment is considered a desirable commodity produced with income and parental time [36, 368, 434]. Hours spent in the labour market provide money to buy market goods; the educational output is affected

by parental ability to combine these resources with non-market time spent on household production [37]. The resources within a family depend on the number of people and how much disposable income they have. Household economics considers the family as not only a consuming but also a producing unit and that a combination of time and resource inputs produces different types of commodities (e.g., behavior and academic performance of children) [37, 368]. To produce 'quality children', parents must provide some resources to foster an environment that promotes and provides formal education. Children's educational attainment has been shown to be positively related to parental inputs of income [55, 253].

The family plays an important role in the educational performance of children. The theories and models mentioned above show conceptual divergence between families in the cultivation of their children, and families with different structures could work differently in accordance with these models. As such, we focus on investigating the role of the family structure in influencing children's academic performance.

3.3 Literature review

The type of family structure in which children are raised has significant impact on children academic performance [43], and most previous studies have consistently found that growing up in different emerging family structures has negative consequences for education [397]. Furthermore, compared to children who grew up in two-parent families, children who grew up in single-parent families typically had lower academic achievement levels (e.g., [146, 220, 372]). Studies on child outcomes in skipped-generation households showed that children in these living conditions tend to have low academic achievements and educational qualifications [136, 396]. However, results of studies focusing on the academic performance of children from immigrant households are inconsistent [277].

Besides, evidence indicates that the level of socioeconomic resources and parenting involvement are the two main determinants of children educational performance, and these attributes vary in systematic ways with the type of family structure [121, 218].

3.3.1 Socioeconomic resources

The impact of socioeconomic resources on educational outcomes is well established. The availability of material and finance resources determines the quality and access of chil-

dren to school programs, technology, extracurricular activities and new experiences which shape their academic success [314]. High socioeconomic status (SES) households have these resources and they enable children access to high quality education and promote high academic performance [115]. Parents from high-SES also tend to have a degree qualification, master a foreign language and have a high level of cultural knowledge [303] – all of which are translated into higher educational performance amongst their children, compared to those from more disadvantaged households [200].

Also, the positive relationship between high-SES and academic performance at early stage of life tends to persist from childhood to adolescence and is consistent across ethnic groups [316, 435, 4, 80, 251, 356]. The persistence of this relationship reflects the recursively of learning as early learning lays down the foundations for later attainment and triggers a self-reinforcing motivation for further learning [208]. Consistently, research has found that children from high-SES households develop academic skills faster than children from those from lower SES families [311]. Furthermore, SES leads to significantly higher overall performance scores in Mathematics and English subjects [142].

SES also tends to vary in systematic ways with the type of family structure. Single-parent households are more likely to be poor compared to two-parent households [183, 57]. Single parents are challenged to balance work and child care duties, and they are more likely remain in low-paid work [113, 177]. In Taiwan, poverty rates for single-male or single-female headed households have been reported to be four times higher than for two-parent households: 4.32% for two-parent households, and 19.74% and 22.55% are for single-male and single-female headed households, respectively, in 2009 [422].

Children from skipped-generation households also tend to be constrained by socioeconomic circumstances. Previous research indicates that skipped-generation households are more likely to fall below the poverty line [82, 318, 307, 179]. Additionally, children from skipped-generation households have been found to achieve lower academic performance and being less likely to graduate from high school than children from two-parent households [120]. Limited socioeconomic resources have been cited as the main reason for this low level of educational achievement for skipped-generation household children [120, 396].

Differences in SES also exist between native and immigrant households. The extent and form of these differences, however, depend on the time, ethnicity, visa status and language similarity of immigrants in the host country [349, 25]. During the early years after migration, immigrants are less likely to be working full-time or participate in the labour force and are likely to earn a low salary than natives before they escalate up the

occupational hierarchy [53, 6, 365]. The median income of immigrant households is on average 13% and 17% lower than in native-born households in the European Union and in the OECD, respectively [151].

In Taiwan, immigration has been largely drawn from China and neighbouring Southeast Asian countries, including Vietnam, Indonesia, and Thailand [420]. In 2018, over 89% of primary school children's parents were from Mainland china, Vietnam, Indonesia or Thailand. Based on the most recent data from the Taiwanese Ministry of the Interior, over 453 thousand foreign female spouses have immigrated from China (338 thousand) and Southeast Asian countries (155 thousand) to marry Taiwanese men since 1987. The percentage of foreign brides accounted for 14.1% of registered marriages in 1998, rising to 28.4% in 2003 [240]. Pronounced differences in SES exist between local and immigrant households. Taiwanese women tend to be more educated and be better paid than immigrant females, particularly than those recently arrived to the country [96]. Evidence from China indicates that these SES circumstances tend to correlate with low academic performance among children from immigrant households [446].

3.3.2 Parenting

In addition to socioeconomic resources, parental involvement is also a main factor contributing to explain children educational performance. Increased parental attention, time, support and dedication are key in promoting and facilitating learning [181]. Active parental participation in children's school activity encourages long-term educational and career aspirations in their children [33]. Kao and Tienda [245] showed that frequent parental engagement with school activities positively affect children academic achievement through mechanisms such as modelling, reinforcement and instruction [223]. However, the level of parental influence on children educational performance depends on key factors defining the parental-child relationship: particularly how close children feel to their parents (i.e., parent-child attachment); the level of direct supervision that children receive from parents (i.e., average time of parental attention); and, the style of parenting (i.e., authoritative parenting style which means high responsiveness plus high demandingness has been linked with adaptive achievement strategies characterised by low levels of failure expectations, task irrelevant behaviour and passivity coupled with high levels of independent problem solving and critical thinking, which could promote academic achievement) [186, 387, 185, 20, 348].

These parental engagement factors tend to vary in systematic ways across family struc-

tures, suggesting consistent differences in parental involvement and thus in children educational performance. The average time of parental attention and support tend to be greater in traditional two-parent households compared to one-parent households as single carers are challenged to balance work and other domestic responsibilities [10]. Additionally, reduced grandparent-children attachment is expected in skipped-generation household due to major generational gaps in the use of new technology, fashion and trends [98]. For transitional households, the extent of parental involvement may be reduced. Long work patterns reported by immigrants may not fit with school periods and generate extended times with absence of dedicated caring [138]. Immigrants' limited local language proficiency may also undermine their capacity to assist their children with school content [245].

Additionally, the style of parenting has also been found to vary across family structures. Single mothers often confidantes of their children [123, 427] and tend to use a more flexible parenting style than mothers from two-parent household structures [126]. But this style of parenting is gender biased as single mothers tend to be more permissive parenting to their sons than daughters [126]. Single fathers, on the other hand, are consistently more permissive to both son and daughter, compared to fathers from two-parent households [126]. Similarly, parents from immigrant households tend to be equally permissive to children of both sexes [126]. For skipped-generation households, parenting practices do not appear to have been investigated.

3.4 Data

3.4.1 Data source

To evaluate the impact of various family structures on the academic performance of children in Taiwan, this study uses a dataset from the Taiwan Assessment of Student Achievement (TASA) which is administered by the National Academy for Educational Research Preparatory Office. TASA is nationally representative. A two-stage stratified sampling design is implemented to determine the chosen schools and children. In the first stage, the sampling unit consisted of schools which are stratified with two variables such as district size and school size. Then, schools were systematically sampled with probabilities that were proportional to the measure size. In the second stage, the sampling units were classes within chosen schools based on a simple random sampling method [441]. The assessment framework, performance standards, scoring rubrics, and sample items or tasks are available

online (http://tasa.naer.edu.tw/).

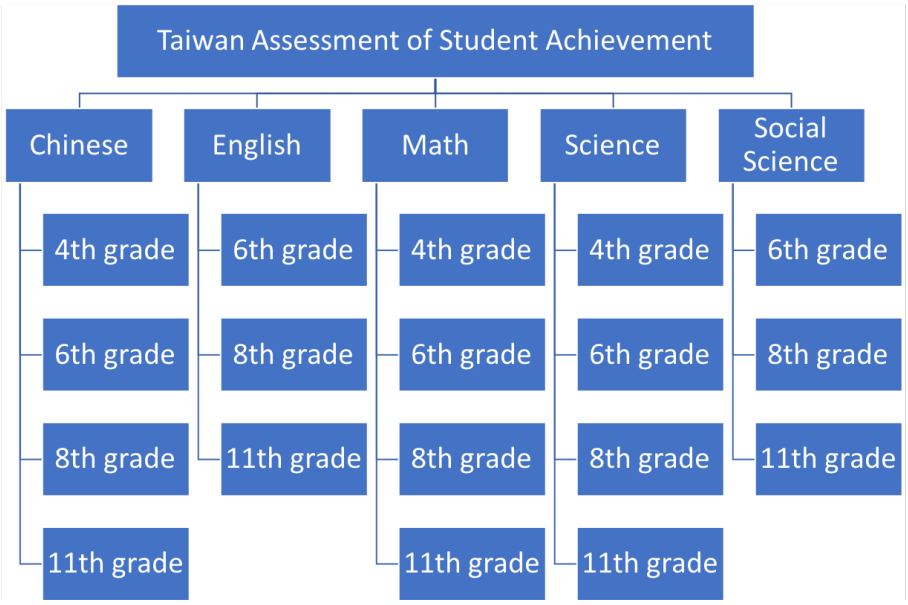


Figure 3.1: The structure of Taiwan Assessment of Student Achievement

TASA assesses the extent to which 4th, 6th, 8th and 11th grade children (See Figure 3.1). It assesses if children have acquired key knowledge and skills on the academic learning in the Taiwanese national curriculum. The assessment is implemented across primary and secondary schools in all 23 counties of Taiwan. At 4th, 6th, 8th and 11th grades, the median age of children is 10, 12, 14 and 17 years. TASA focuses on the core school subjects of Chinese, English, Mathematics, Science and Social science. Children of 4th grade are not assigned to participate in the English and Social science test. Each child is randomly assigned to undertake an examination on two school subjects, the 10 possible combinations are as follows: Chinese and English, Chinese and Math, Chinese and Science, Chinese and Social science, English and Math, English and Science, English and Social science, Math and Science, Math and Social science, Science and Social science. Children are assigned to complete a questionnaire which collects their background information, including gender, number of siblings, family structure, family environment (amount of socioeconomic resources, language use, guardians' educational level), and aspects of children's lives (attitudes towards learning, their habits and life in and outside of school). The questionnaire however does not collect information on residential and school location and school and

classroom attributes, so the influence of these factors cannot be assessed. Nonetheless, spatial socio-economic inequalities across schools and neighbourhoods in Taiwan are small [395]. PISA results indicate that socio-economic inequalities between urban schools and non-urban schools in Taiwan are relatively small compared to other OECD Asian countries [149]. So, the influence of residential and school factors on children economic performance are expected to be less pronounced than individual and household attributes. This is in line with evidence in countries with small interpersonal socio-economic inequalities, like Australia [364].

Table 3.1 shows the detailed time schedule of TASA assessment. For this study, we used data on 8th grade children in 2007, 2010 and 2013 and the sample size are 18,444, 20,530, and 21,054, respectively. The sample size of the pooled sample of three years is 60,028. We used data on 8th grade children because of two key reasons. First, this grade is the closest time point of observation available to the end of their compulsory education.[5] Second, achievement in junior school is an important factor affecting children's choice of high school, vocational school or not continuing to study in Taiwan [279]. Understanding children educational performance at 8th grade is thus important to guide policy formulation and planning for better educational outcomes later in life reinforcing the educational offer in earlier years. We do not use 2006 TASA data because they do not provide the relevant details to define family structures to be consistent with later years.

3.4.2 Measure of academic performance

To measure academic performance, we use students' test score of subject assessments from the TASA examination. Test scores are commonly used to assess children's academic performance in the literature [116]. We construct a test score variable by calculating the ratio of the correctly answered number of questions to the total number of questions, and then multiply by 100. This score would range from 0 to 100, with a score of 80 indicating that 40 correctly answered questions from 50. In addition, students are assigned to take examinations in several subjects, so that a student's cross-subject performance is assessed by the simple average of test scores of all subjects the student takes.

[5]Before 2014, the 9-year compulsory education including 6-year elementary school and 3-year junior school is implemented in Taiwan.

Table 3.1: Timetable for Taiwan Assessment of Student Achievement

Year	Term	Education Level			
		4th	6th	8th	11th
2005	1st	Pilot (2006)	Pilot (2006)	Pilot (2006)	Pilot (2006)
	2nd	-	Formal (3)	-	-
2006	1st	Pilot (2007)	Pilot (2007)	Pilot (2007)	Pilot (2007)
	2nd	Formal (4)	Formal (5)	Formal (5)	Formal (5)
2007	1st	Data analysis	Data analysis	Data analysis	Data analysis
	2nd	Formal (4)	Formal (5)	Formal (5)	Formal (5)
2008	1st	Pilot (2009)	Pilot (2009)	-	-
	2nd	Data analysis	Data analysis	Data analysis	Data analysis
2009	1st	Data analysis	Data analysis	Pilot (2010)	-
	2nd	Formal (4)	Formal (5)	-	-
2010	1st	-	-	Data analysis	Pilot (2011)
	2nd	-	-	Formal (5)	-
2011	1st	Pilot (2012)	Pilot (2012)	-	Data analysis
	2nd	-	-	-	Formal (5)
2012	1st	Data analysis	Data analysis	Pilot (2013)	-
	2nd	Formal (3)	Formal (5)	-	-
2013	1st	-	-	Data analysis	Pilot (2014)
	2nd	-	-	Formal (5)	-
2014	1st	Pilot (2015)	Pilot (2015)	-	Data analysis
	2nd	-	-	-	Formal (5)
2015	1st	Data analysis	Data analysis	Pilot (2016)	-
	2nd	Formal (3)	Formal (5)	-	-
2016	1st	-	-	Data analysis	Pilot (2017)
	2nd	-	-	Formal (5)	-
2017	1st	Pilot (2018)	Pilot (2018)	-	Data analysis
	2nd	-	-	-	Formal (5)

[1] Note: Pilot (2006) indicates the pilot test for 2006. Formal (3) indicates the formal test including three subjects such as Chinese, Math and Science. Formal (4) indicates the formal test including four subjects such as Chinese, English, Math and Science. Formal (5) indicates the formal test including five subjects such as Chinese, English, Math, Science and Social science.

[2] Sources: Taiwan Assessment of Student Achievement for 2005-2017

3.4.3 Definition of family structures

We defined four non-overlapping types of family structures: two-parent, single-parent, skipped-generation, and immigrant household structures. In this study, *Two-parent households* comprised a Taiwan-born couple and its biological, step, and adopted/foster children. *Single-parent households* are households headed by only one single parent (either native or foreign) and their biological, step, and adopted/foster children. *Skipped-generation households* refer to households in which children live with their grandparent(s) and without the parents of the grandchildren. *Immigrant households* are defined as households in which one or both of the parents are overseas born, and we also divide immigrant households into two types. First, households with a foreign-born parent and a native parent. Second, both parents are born abroad.

3.5 Methodology

We used a quasi-experimental design to estimate the causal effect (or Average Treatment Effect (ATE)) of family structures on children academic performance [288, 297]. It involves a two-stage approach. First, we used PSM to identify a comparable sample of individuals in our control (two-parent families) and treatment (skipped-generation households, single-parent households, and immigrant households) groups. Second, we performed a series of regression models based on these samples to estimate the influence of family structures on children's school scores. Previous studies have traditionally relied on simple regression approaches to investigate the relationship between particular family structures and children school performance [220]. However, obtaining reliable results from these studies requires removing the potential impact of disturbing factors. Simply using OLS to assess children's academic performance between the types of family structure would generate estimates that could potentially be influenced by other factors. For example, if children come from different family structures, the sampling process may not ensure sufficient representativeness of the observations in each family structure, so that a significant gap in performance between children from one group and children from another group could be caused by the sample selection problem. This is a pervasive problem for empirical research that uses survey data, even if regression modelling has controlled all available predictors. For this study to achieve a more convincing result, an adjustment to sample representativeness is therefore necessary. As a result, we use a propensity score weighting approach to deal with this

problem.

3.5.1 Propensity score matching

Intuitively, PSM approaches are typically used to estimate the causal effect of a treatment (e.g., medical treatment, policy intervention or training programme). They enable addressing the challenge arising from the fact that individuals in the treatment and control group may not be a product of random assignment, and these groups may instead differ in systematic ways. PSM approaches enable the identification of comparable individuals in the treatment and control groups based on observed attributes. This is done in a three-step process: (1) defining a metric of 'similarity'; (2) using this metric to match control and treatment observations; and, (3) discarding unmatched observations [16].

We applied a novel matching approach, which combines the estiamtion of propensity score estimated with Extreme Gradient Boosting (XGBoost) - or Generalised Boosted Models (GBM). Unlike traditional matching approaches, such as multinomial logistic or probit approaches which rely on the correct specification on parameters to achieve a better performance of eliminating confounding factors, GBM incorporate machine learning algorithm to search for optimal matching outcomes (i.e., the optimal number of control cases to be matched to each treated unit) and optimal weighting of matched control units to each treated unit [297, 310]. Particularly GBM help address two key issues. First, standard matching approaches can handle one treatment at the time, restricting the analysis to a reduced subset of observations as unmatched observations are discarded [391]. Normally the resulting sample involves one-to-one matching and can vary considerably in size with different matching strategies [391]. GBM enables handling of multiple treatments at the same time and using the full sample. Handling of multiple treatments is important in our application given that we consider non-traditional family structures are different treatment groups *versus* traditional two-parent families (the control group) [257].

Second, misspecification of the propensity score model is often a key issue resulting in poor estimates of the propensity scores, poor matches and biased estimates of the treatment effect [257]. Propensity scores are usually estimated with logistic regression which imposes parametric assumptions and thus restricts the functional form relating to the underlying distribution of the population. GBM approach the estimation of the propensity scores as a prediction problem based on a non-parametric boosting machine learning algorithm. Boosting is an automated and adaptive algorithm that can be applied to study

cases involving a large set of pretreatment covariates to fit a nonlinear surface and predict treatment assignment [298]. Boosting outperforms alternative methods such as logistic model analysis in terms of prediction error [162, 294]. There are many variants of boosting in the machine learning and statistics literature, including AdaBoost algorithm [159], generalised boosted models [360], and gradient boosting machine [162]. We used GBM because, compared to other implementations of boosting, this method is designed to produce models yielding well-calibrated propensity scores (or probability estimates); that is, probability estimates matching the empirical probabilities of treatment [298].

Implementing generalised boosted models (GBM)

To implement GBM, we considered each of our three non-traditional family structure as separate treatment groups (skipped-generation households, single-parent households, and immigrant households) and traditional two-parent families as the control group. First we estimated the propensity score to identify children with similar observable attributes from each non-traditional household to those from two-parent families. Formally the propensity score is defined as:

$$Pr(K_i = k|x_i) \equiv p_k(x_i) = \frac{e^{g_k(x_i)}}{1 + \sum_{k=1}^{3} e^{g_k(x_i)}},\ k \in \{1, 2, 3\}. \tag{3.1}$$

where: x_i is the covariates of a child i. $p_k(x_i)$ is the propensity score for a child i in a non-traditional family k; that is, 1 for a single-parent, 2 for a skipped-generation, and 3 for an immigrant family structure. The propensity score for the control group (i.e., children from a two-parent family) was estimated as follows:

$$p_0(x_i) = 1 - \sum_{k=1}^{3} p_k(x_i) = \frac{1}{1 + \sum_{k=1}^{3} e^{g_k(x_i)}}. \tag{3.2}$$

To estimate propensity scores for multiple treatments, a log-likelihood function is used based on a joint Bernoulli random trial, in Equation (3.3). A household structure indicator z_{ki} was created to identify a child i from family structure k; where z_{ki} equals 1 if a child

belongs to a given non-traditional family structure ('treatment'); and, 0 otherwise.

$$\begin{aligned} L(g) &= \sum_{i=1}^{N} ln\{p_1(x_i)^{z_{1i}} \times p_2(x_i)^{z_{2i}} \times p_3(x_i)^{z_{3i}} \times (1 - \sum_{k=1}^{3} p_k(x_i))^{(1-\sum_{k=1}^{3} z_{ki})}\} \\ &= \sum_{i=1}^{N} \{\sum_{k=1}^{3} z_{ki} \times g_k(x_i) - ln(1 + \sum_{k=1}^{3} e^{g_k(x_i))}\} \end{aligned} \tag{3.3}$$

Based on Equation (3.3), GBM was used to find a set of $g_k(x_i)$ that maximises the likelihood function, i.e., good matches. This process consists of many simple regression trees, in which the trees are combined iteratively to gradually approach the maximization of likelihood by providing the best fit for the residuals of the previous iteration.[6] The desired estimate of $g_k(x)$ is given by following argument,

$$g^* \equiv \arg\max_{g} \{L(g)\}, \; where \, g = \{g_1, ..., g_k\}. \tag{3.4}$$

The g^* are used to compute the propensity scores defined in Equation (3.1) and (3.2).

Estimating the average treatment effect (ATE)

To estimate the ATE of family structures on children's academic performance, the resulting propensity scores were used as statistical weights. A weight of $1/p_k(x_i)$ were applied for children from skipped-generation, single-parent, and immigrant household, and a weight of $1/\{1 - \sum_{k=1}^{3} p_k(x_i)\}$ was given to children from two-parent household; where $p_k(x_i)$ is the estimated propensity score for child i to receiving a treatment k.[7] The use of propensity score weighting is similar to the use of sampling weights in survey data analysis to account for unequal probabilities of inclusion in a study example. In essence, treated and untreated groups are weighted to have a similar composition in terms of the observed attributes captured in the data (see [272]). We applied the propensity score weights to produce a balanced dataset in a first stage to estimate the ATE of family structures on children's educational performance in a second stage.

[6]The maximum number of trees is 10,000, and the assessment for balance of covariates among the control and treatment groups is affirmed by using absolute standardised mean difference (ASMD) and Kolmogorov-Smirnov (KS) statistics.

[7]The inverse probability of treatment weighting method is used to further estimate the ATE. For more detail, please see: Yuan et al. [442]. Propensity Score Methods for Causal Inference with the PSMATCH Procedure. In Proceedings at the SAS Global Forum 2017 Conference. Cary, NC: SAS Institute.

We estimated three different sets of regression models. The first set of models was used to estimate the overall ATE across our sample; the second was used to estimate discipline-specific ATEs; and, the third was used to estimate year-specific ATEs. For the first set of models, we used children's averaged individual test score to create an overall test scores. Averages were computed using data for two subject disciplines as children are only required to complete only tests in two different subjects. So we averaged, for example, the scores for Math and Society, or Math and English. Formally the model can be represented by:

$$\bar{Y}_i = \alpha_0 + \beta_0 FS_i + \gamma_0 C_i + \sigma_0 S_i + \nu_i, \tag{3.5}$$

where; i denotes children; $\bar{Y}_i$ represents the overall average test score of an individual i across the two disciplines for which examination was undertaken; FS represents each of our four family structures: two-parent, single-parent, skipped-generation and immigrant households and captures variations in academic performance due to differences in family structure. C is a vector of variables capturing children's individual characteristics, including gender and number of siblings.[8] S is a vector of variables capturing children's family background, specifically their guardian's education level, language used at home, availability of computers and books at home. ν_i, correspond to the residual term.

In our analysis we sought to identify differences in academic performance arising from systematic family differences in socio-economic resources and parenting styles. We thus included covariates to control for educational attainment of parents/guardians, possession of at least a computer, and the number of stored books at home to capture the influence of household socio-economic resources, and isolate the effect of parenting styles, which we argue, is measured by differences in family structures. Table 3.2 lists and describes the variables included in our regression models.

The second set estimates discipline-specific ATEs of children's family structures on their educational performance. We expect some systematic discipline-specific differences across children from different family backgrounds. For instance we expect differences in student performance across disciplines as having an English speaking immigrant background may be linked to high scores in English examinations but low scores in Chinese or Social Science

[8]Notably, as discussed in previous literature, it is concerned with the relationship between the number of siblings and children's academic performance (see [9, 357, 358, 378, 129]). The main idea is that the parental resource within a family is finite, and the amount of resource that can be distributed to a child is determined by the number of children within that family, which could in turn influence academic outcome of that child. Because of that, we include the presence of siblings as a control variable in the model.

Table 3.2: Description of variables

Variables	Description of Variables
Dependent Variable	
Average Test Score_i	Overall average test score of an individual i across the two disciplines for which examination was undertaken; from 1 to 100 points.
Test Score_i j	Test score of individuai i in discipline j; from 1 to 100 points.
Average Test Score_i t	Overall average test score of an individual i across the two disciplines in year t for which the examination was undertaken; from 1 to 100 points.
Independent Variables	
Family Structure	
Two-parent (Baseline)	1 for children grew up in two-parent households; 0 otherwise.
Skipped-generation	1 for children grew up in skipped-generation households; 0 otherwise.
Single-parent	1 for children grew up in single-parent households; 0 otherwise.
Immigrant	1 for children grew up in immigrant households; 0 otherwise.
Personal and Family Background	
Gender	1 for male, 0 for female (Baseline).
Siblings	1 for sibling presence, 0 for the onlt child at home.
Male guardian's education level	7 categorise: illiterate, complete elementary school, complete junior school, complete senior high school, complete junior college, complete university, complete graduate school or above (Baseline).
Female guardian's education level	7 categorise: illiterate, complete elementary school, complete junior school, complete senior high school, complete junior college, complete university, complete graduate school or above (Baseline).
Home computer	1 for at least a computer at home, 0 for no computer at home (Baseline).
Stored books	3 categorise: low (lower than 25 books- Baseline), medium (26 books to 100 books), high (more than 100 books)
Chinese-speaking	1 for Chinese-speaking households, 0 for non-Chinese speaking households (Baseline).

tests. We estimated the following model:

$$Y_{ij} = \alpha_{1j} + \beta_{1j} FS_i + \gamma_{1j} C_i + \sigma_{1j} S_i + \pi_{ij}, \tag{3.6}$$

Here we note that test scores and covariates vary by children and discipline j (Chinese, English, Math, Science and Social science), and the regression coefficients would be separately estimated for each discipline.

The third set of regression models estimate year-specific ATEs of children's family structures on their educational performance, in order to establish the extent of persistence in the observed effect. We estimated the following model:

$$\bar{Y_{it}} = \alpha_{2t} + \beta_{2t} FS_{it} + \gamma_{2t} C_{it} + \sigma_{2t} S_{it} + \varepsilon_{it}. \tag{3.7}$$

where: t denotes year (2007, 2010 and 2013).

3.6 Results

This section first present some descriptive statistics on the composition of family structures before discussing the results derived from our regression analysis.

3.6.1 Descriptive analysis

Table 3.3 shows the distribution of children across our four family structures for our pooled sample, including data from 2007, 2010 and 2013. It shows that two-parent families account for the largest type of family structure. About three quarters of children in the sample tend to live in two-parent households. This type of family structure is however declining. The share of children living in non-traditional family structures is on the rise. Jointly, the percentage of children living in skipped-generation, single-parent and immigrant increased from 21.78% in 2007 to 34.70% in 2013. Children living in single-parent families represent the largest increase (by 8.84%) followed by children living in immigrant households rising by a 3.16%. The percentage of children living in skipped-generation families also seems to be growing but at a lower rate.

For immigrant families, more than 90% of immigrant families are households with only one foreign-born parent, while only 10% of immigrant families are households with both foreign parents. Moreover, the percentage of immigrant households with only one foreign parent is rising from 1.51% in 2007 to 4.76% in 2003.

Table 3.3: Sample size of whole sample and by family structures

Family Structure	Whole Sample	2007	2010	2013
Two-parent	70.79%	78.22%	69.74%	65.30%
Skipped-generation	3.00%	2.49%	3.05%	3.41%
Single-parent	22.90%	17.41%	24.39%	26.25%
Immigrant	3.31%	1.88%	2.82%	5.04%
Immigrant (One)	3.00%	1.51%	2.54%	4.76%
Immigrant (Both)	0.31%	0.37%	0.28%	0.28%
Observations	60,028	18,444	20,530	21,054

Table 3.4 shows the distribution of children in our sample across individual and family characteristics. Overall, there is a balanced sex ratio and children are drawn largely from Chinese-speaking households (85.06%). Most children have siblings (89.90%). The

distribution of male-guardians and female-guardians' education level is quite similar. And, we observe significantly lower density in groups of illiterate and elementary school and higher density between groups of junior school and graduate school or above. In terms of socioeconomic resources at home, most children have at least one computer (96.35%). Equal proportions of children report having 0-25, 26-100 and 100+ books.

Table 3.4: Summary statistics of variables by family structures

	Whole Sample	Family Structure					
Variables		Two-parent	Skipped-generation	Single-Parent	Immigrant	Immigrant (one)	Immigrant (both)
Gender							
Male	51.24%	51.22%	53.59%	51.21%	49.67%	48.92%	57.07%
Female	48.76%	48.78%	46.41%	48.79%	50.33%	51.08%	42.93%
Siblings							
Sibling presence	89.90%	92.53%	79.63%	83.63%	86.40%	86.35%	86.96%
Only child	10.10%	7.47%	20.37%	16.37%	13.60%	13.65%	13.04%
Male Guardian's Education							
Illiterate	0.85%	0.58%	1.67%	1.23%	3.55%	3.13%	7.74%
Elementary school	5.02%	4.19%	8.14%	6.66%	10.47%	10.88%	6.45%
Junior school	19.58%	17.99%	28.69%	23.18%	24.91%	26.06%	13.55%
Senior high school	40.50%	40.46%	45.28%	41.24%	32.96%	32.57%	36.77%
Junior college	12.69%	13.79%	7.15%	10.35%	7.40%	7.82%	3.23%
University	14.45%	15.20%	6.93%	12.75%	14.44%	13.55%	23.23%
Graduate school or above	6.92%	7.78%	2.13%	4.59%	6.27%	5.99%	9.03%
Female Guardian's Education							
Illiterate	0.93%	0.52%	2.67%	1.50%	5.31%	4.84%	9.80%
Elementary school	5.07%	4.42%	7.69%	6.11%	11.23%	11.51%	8.50%
Junior school	15.81%	15.08%	21.36%	16.98%	20.67%	20.84%	18.95%
Senior high school	48.13%	48.43%	48.95%	48.98%	34.61%	34.67%	33.99%
Junior college	12.89%	13.77%	7.61%	11.34%	7.09%	7.36%	4.58%
University	13.72%	14.19%	9.87%	12.15%	16.29%	16.08%	18.30%
Graduate school or above	3.45%	3.59%	1.86%	2.94%	4.81%	4.70%	5.88%
Home Computer							
Yes (1+)	96.35%	97.60%	85.68%	93.91%	96.28%	96.39%	95.11%
No	3.65%	2.40%	14.32%	6.09%	3.72%	3.61%	4.89%
Stored books							
Low (0-25)	35.51%	30.34%	58.97%	47.25%	43.80%	43.72%	44.57%
Medium (26-100)	32.54%	33.72%	25.36%	29.97%	31.50%	31.67%	29.89%
High (100+)	31.95%	35.94%	15.66%	22.77%	24.70%	24.61%	25.54%
Main Language							
Chinese-speaking	85.06%	85.10%	77.73%	85.67%	86.52%	86.75%	84.24%
Non-Chinese speaking	14.94%	14.90%	22.27%	14.33%	13.48%	13.25%	15.76%
Observation	60,028	42,493	1,802	13,746	1,987	1,803	184

Differences are, however, observed across household structures. Notably skipped-generation households record the largest share of only child, use of a non-Chinese language at home and seems to be the most disadvantaged group in terms of computer and book resources. Compared to two-parent families, these percentages are also larger for single-parent and immigrant households. Immigrant households also display the largest share of illiterate guardians, both females and males. Also, in terms of educational attainment, guardians in the immigrant family are not necessarily as bad as being suggested in the previous research. Indeed, the educational attainment of guardians in immigrant families is quite similar to those in two-parent families when we examine the top part of the education

levels (with bachelor or higher degrees). The proportion of male guardians in two-parent, skipped, single-parent and immigrant families with a bachelor's degree or higher is either 22.98%, 9.06%, 17.34% and 20.71%, which implies a similar proportion in higher education for male guardians in two-parent and immigrant families. This phenomenon is also observed for female guardians. The proportion of female guardians in two-parent, skipped, single-parent and immigrant families with a bachelor or higher degree is 17.78%, 11.73%, 15.09%, and 21.1%.

Table 3.5 shows the overall children's average test scores by family structure revealing consistently higher scores for children from two-parent households. Children from skipped-generation and single-parent families register the lowest scores, remarkably low for the former and displaying a sharp decline from 50.10 in 2010 to 46.48 in 2013. Children in immigrant families have average scores around 60 across all three years in analysis. By splitting the immigrant household into a household with only one parent is foreign-born, and with both foreign-born parents, two different trends are observed in the average score of these two types of households, the former falling down the timeline and the latter behaves in the opposite direction.

Table 3.5: Sample means of test scores by year and family structures

	2007	2010	2013
Whole Sample	61.58	61.89	61.09
Two-parent	63.25	64.54	64.23
Skipped-generation	47.99	50.10	46.48
Single-parent	56.00	55.99	55.44
Immigrant	61.76	60.24	59.67
Immigrant (One)	62.89	60.55	59.48
Immigrant (Both)	57.11	57.51	62.96

3.6.2 Regression results

Next we analysed if family structures are associated with children's educational performance. We are particularly interesting in establishing a causal link; that is, whether children's family structure has any impact on their educational performance. We hypothesised that non-traditional household structures may negatively impact children educational advantage due to differences in parenting styles, language, time and financial resources.

To measure the causal effect of family structures on children academic performance, we used PSM identify comparable children from two-parent and non-traditional household structures, and applied regression analysis to estimate the AVE of being associated with a non-traditional family on children's overall test score.[9]

Overall impact

Table 3.6 presents the regression results for a first set of models based on a pooled dataset of the three years in analysis. Three models are presented, and the key difference between these models is that Model (1) excludes home computer and stored books variables which are included in Model (2) to account for differences in socio-economic resources across children. The immigrant family is further classified as only one parent born abroad, or both parents are born abroad in Model (3). Focusing on family structures, our results reveal that children from two-parent families show the highest educational achievements (i.e., average overall test scores). Compared to children from two-parent households, those from skipped-generation and single-parent households tend to perform much worse with average overall test scores up to 11.13 points lower.

Model (2) however indicates that differences in academic performance due to variations in family structures are less pronounced after controlling for socio-economic resource. The score gap between children from two-parent families and non-traditional family structures reduces. The coefficient for skipped-generation falls from -11.13 points to -8.52 points, from -6.10 points to -4.67 points for single-parent households. The significant score gap between children of immigrant households and those of two-parent households becomes insignificant. This finding suggests that having an adequate provision of resources can help remedy issues of disadvantage affecting children educational performance within non-traditional households. At the same time, it also suggests that differences in socio-economic resources only account for a small share of the difference in school grade across children.

Children's personal characteristics also play a role in explaining these differentials. Being males and having siblings are negatively associated with children school performance. Males tend to achieve 2.41 points below females, while children living with siblings attain average scores 1.35 points lower than children with no siblings. Conversely, guardians' educational level positively relates to children's educational performance. Relative to

[9]Technically speaking, the weight obtained from propensity score matching is incorporated with survey-weighted regression, and the estimates are obtained with consideration of correction to heteroscedasticity of variance and covariance matrix.

Table 3.6: Regression coefficients of different family structures

	(1)	(2)	(3)
Skipped-generation	-11.125 ***	-8.516 ***	-8.513 ***
	(0.750)	(0.750)	(0.757)
Single-parent	-6.099 ***	-4.674 ***	-4.671 ***
	(0.218)	(0.216)	(0.217)
Immigrant	-1.087 **	-0.788	
	(0.534)	(0.519)	
Immigrant (one)			-0.770
			(0.545)
Immigrant (two)			-1.139
			(1.948)
Gender	-2.777 ***	-2.410 ***	-3.995 ***
	(0.464)	(0.458)	(0.716)
Sibling presence	-1.266 **	-1.346 **	-0.082
	(0.600)	(0.615)	(1.346)
Male Guardian-illiterate	-14.829 ***	-12.149 ***	-11.451 ***
	(2.222)	(2.216)	(2.501)
Male Guardian-elementary	-17.487 ***	-15.088 ***	-13.048 ***
	(1.859)	(1.689)	(2.329)
Male Guardian-junior	-15.188 ***	-13.504 ***	-12.775 ***
	(1.770)	(1.536)	(1.970)
Male Guardian-senior high	-12.294 ***	-11.273 ***	-10.704 ***
	(1.737)	(1.497)	(1.866)
Male Guardian-junior college	-5.572 ***	-5.492 ***	-6.224 ***
	(1.862)	(1.616)	(2.039)
Male Guardian-university	-4.580 ***	-4.532 ***	-3.895 **
	(1.752)	(1.514)	(1.875)
Female Guardian-illiterate	-9.485 ***	-6.716 ***	-7.269 ***
	(2.440)	(2.103)	(2.680)
Female Guardian-elementary	-7.382 ***	-5.195 ***	-5.318 **
	(2.186)	(1.881)	(2.694)
Female Guardian-junior	-7.834 ***	-6.011 ***	-6.177 **
	(2.115)	(1.774)	(2.494)
Female Guardian-senior high	-4.594 **	-3.826 **	-4.924 **
	(2.075)	(1.712)	(2.364)
Female Guardian-junior college	0.350	-0.146	-1.425
	(2.199)	(1.804)	(2.396)
Female Guardian-university	-2.347	-1.928	-3.562
	(2.114)	(1.783)	(2.452)
Chinese-speaking	5.791 ***	4.879 ***	4.289 ***
	(0.604)	(0.628)	(1.005)
Home-computer		5.867 ***	6.632 ***
		(0.843)	(1.049)
Stored books (Medium)		6.491 ***	7.286 ***
		(0.508)	(0.914)
Stored books (High)		9.220 ***	9.955 ***
		(0.583)	(0.993)
Constant	76.503 ***	64.214 ***	63.590 ***
	(2.004)	(2.006)	(3.076)
Observation	48,184	48,101	48,101
R-square	0.192	0.219	0.206
AIC	449,200	445,800	454,600

[1] Estimates with stars are those statistically significant, where *, **, and *** respectively indicates the p-value to be smaller than 0.1, 0.05 and 0.01.
[2] Standard deviations are in parentheses.

guardians' with graduate school or above qualification (base category), children of parents with lower educational levels tend to display lower academic scores. Additionally, the results indicate that male guardian's educational attainment is likely to have a larger influence on children's academic performance than female guardians. Children with illiterate male guardian, for instance, report an average of 12.15 points lower than those with graduate school or above qualifications. However, the average score differential between children with an illiterate female guardian and children with a literate female guardian is less than 6.72 points.

Considering children's background, those from Chinese-speaking households tend to outperform those raised in non-Chinese speaking households. This may be because Chinese is the main language spoken at school. Hence, proficiency in Chinese may allow children to more easily learn instructions and nuances in the class content. The results also show, as expected, that having educational resources positively impacts educational attainment. Owning at least one computer and a larger number of books are linked to higher test scores by up to 9.22 points: this is consistent with existing empirical evidence indicating that high-SES households, with enough material and finance resources, enable high children academic performance [115].

Moreover, Model (3) compares children of different compositions of immigrant families and children in two-parent families, single-parent families and skipped-generation families. Immigrant families are divided into two groups. Firstly, only one of the parents is born abroad; secondly, both parents are born abroad. It shows that there is no significant test score gap between children living in immigrant families with the combination of one foreign-born parent and one native-born parent, or those living in immigrant families with both foreign-born parents.

Variation across disciplines

While together these results show that children from non-traditional households tend to be more academically disadvantaged, variations exist across disciplines. Table 3.7 reveals that children from skipped-generation and single-parent households are consistently more disadvantaged across all the five disciplines in analysis, particularly in English and Maths. This may be due to that grandparents in skipped-generation households tend to be out of the workforce, less educated, display poor proficiency in the use of new technology, their knowledge of the national school is likely to be out of date and have a reduced ability to

absorb new knowledge, coupled with the fact that they tend to lack of financial resources to mitigate these deficiencies [122]. For children from single-parent households, poor academic performance may be explained by a likely reduced capacity of single guardians balance work and childcare duties [427]. Children in single-parent households are likely to have higher time constraints compared other family structures.

Children from immigrant households achieve the similar scores to those from two-parent families in Math, Science and Social science. But they perform worse in English, achieving an average score 1.79 points lower than children from two-parent families. The poor performance of children from immigrant families seem to be due to the fact that a large proportion of immigrant households in Taiwan involves mothers from non-English speaking countries from South-East Asian countries. So, English does represent a barrier for children from these families. However, children from immigrant families have better performance on Chinese than two-parent children.

For the additional control variables, the relationship between guardian's education level and children's academic performance is inconsistent across five subjects. However, the influence of home-computer, number of stored books and Chinese-speaking on children's academic performance is consistently positive across five subjects. This result highlights the importance of having educational resources at home. Being a male child, on average, perform worse in language subjects (-5.48 points in Chinese and -6.66 points in English) but perform same in Maths and Science and Social science than female children. This is consistent with existing empirical evidence indicating that girls tend to perform better than boys in language skills learning [173, 389].

Changes over time

We now analyse the temporal persistence of the impact of family structures on children's educational performance. Regression models are separately estimated for each year: 2007, 2010, and 2013. As the models reported in Table 3.7, we added control variables relating to personal and households' characteristics, but we only report the estimates for family structure types. Figure 3.2 plots the 90% confidence interval of family structure's coefficient, which reveals the persistent disadvantaged for children from skipped-generation households and single-parent households versus children from two-parent households.[10]

[10]If zero is not contained in the interval of a coefficient for a particular family structure, there is a significant gap in the academic performance of children between a certain family structure and the two-parent family.

Table 3.7: Regresion coefficients of different family structures by subject

	Chinese	English	Math	Science	Social Science
Skipped-generation	-6.522 ***	-11.409 ***	-10.305 ***	-5.964 ***	-8.713 ***
	(1.224)	(1.344)	(1.732)	(1.199)	(1.070)
Single-parent	-2.416 ***	-6.306 ***	-6.660 ***	-3.845 ***	-3.981 ***
	(0.339)	(0.422)	(0.458)	(0.350)	(0.323)
Immigrant	1.637 **	-1.799 *	-1.317	-1.043	-0.696
	(0.799)	(1.011)	(1.125)	(0.838)	(0.811)
Gender	-5.477 ***	-6.658 ***	0.795	0.385	-0.507
	(0.725)	(0.835)	(1.021)	(0.702)	(0.650)
Sibling presence	-1.065	-5.072 ***	-1.496	-0.580	0.095
	(0.918)	(1.252)	(1.392)	(0.888)	(0.961)
Male Guardian-illiterate	-4.731	-21.698 ***	-13.212 **	-8.274 ***	-10.279 ***
	(4.322)	(3.620)	(4.816)	(2.667)	(3.138)
Male Guardian-elementary	-8.528 **	-19.272 ***	-18.447 ***	-12.095 ***	-9.740 ***
	(3.395)	(2.700)	(3.698)	(2.640)	(2.337)
Male Guardian-junior	-8.580 ***	-17.787 ***	-14.954 ***	-10.102 ***	-9.395 ***
	(3.203)	(2.492)	(3.448)	(2.487)	(1.860)
Male Guardian-senior high	-6.111 **	-15.242 ***	-12.532 ***	-9.498 ***	-6.353 ***
	(3.110)	(2.379)	(3.311)	(2.359)	(1.765)
Male Guardian-junior college	-1.956	-6.727 **	-2.511	-5.073 **	-2.539
	(3.095)	(2.619)	(3.707)	(2.488)	(1.965)
Male Guardian-university	-2.514	-5.346 **	-2.905	-4.788 **	-0.878
	(3.067)	(2.388)	(3.318)	(2.115)	(1.791)
Female Guardian-illiterate	-4.375 *	-18.422 ***	-4.134	-9.397 ***	-5.773
	(2.617)	(3.353)	(5.159)	(3.055)	(3.895)
Female Guardian-elementary	-4.827 **	-14.876 ***	-4.588	-6.707 **	0.548
	(2.400)	(3.041)	(4.819)	(2.922)	(2.842)
Female Guardian-junior	-7.085 ***	-15.033 ***	-4.570	-8.764 ***	-1.235
	(2.197)	(2.844)	(4.670)	(2.960)	(2.567)
Female Guardian-senior high	-4.276 **	-11.456 ***	-2.604	-5.449 **	-0.688
	(2.101)	(2.697)	(4.445)	(2.672)	(2.455)
Female Guardian-junior college	-0.608	-3.803	1.140	-1.148	0.141
	(2.114)	(2.758)	(4.515)	(2.802)	(2.522)
Female Guardian-university	-2.305	-7.298 ***	-1.026	-2.141	-0.415
	(2.397)	(2.828)	(4.520)	(2.429)	(2.402)
Chinese-speaking	3.818 ***	5.713 ***	5.603 ***	5.513 ***	3.138 ***
	(0.930)	(1.159)	(1.157)	(1.020)	(1.020)
Home-computer	5.036 ***	8.628 ***	7.319 ***	3.930 ***	4.478 ***
	(1.188)	(1.310)	(1.727)	(1.240)	(1.730)
Stored books (Medium)	5.625 ***	8.449 ***	6.507 ***	5.810 ***	5.294 ***
	(0.846)	(0.953)	(1.054)	(0.846)	(0.783)
Stored books (High)	8.759 ***	10.712 ***	9.943 ***	8.629 ***	7.590 ***
	(0.955)	(1.114)	(1.296)	(0.959)	(0.872)
Constant	64.525 ***	78.848 ***	56.733 ***	59.507 ***	61.719 ***
	(2.433)	(3.262)	(5.289)	(2.986)	(2.895)
Observation	19,479	18,938	18,781	19,027	18,867
R-square	0.182	0.298	0.175	0.179	0.145
AIC	179,964	182,016	184,824	176,162	172,648

[1] Estimates with stars are those statistically significant, where *, **, and *** respectively indicates the p-value to be smaller than 0.1, 0.05 and 0.01.
[2] Standard deviations are in parentheses.

Children from skipped-generation households are systematically the most disadvantaged. In 2007, children from two-parent households scored 9.81 points higher than children from skipped-generation households, while the gap between children from two-parent households and single-parent households was roughly 5 points, where these two gaps were both statistically significant and lasting from 2007 to 2013.

Figure 3.2 also reveals a shift in the educational performance gap between children from immigrant households and those from two-parent families. In 2007, there was a significant gap of 2.21 points between children from immigrant families doing worse than those from two-parent families. But this situation appears to have been diminished from 2010, with children from immigrant families scoring just no significant difference than children from two-parent families. This phenomenon may be explained by that there are more and more subsidy policies for immigrant families. In order to promote the overall foreign spouse care counselling service, training and development of relates human resources, encourage and provide child care and multicultural promotion programs, the Foreign Spouse Care and Guidance Fund is established by the Ministry of Interior National Immigration Agency since 2005. The fund is increasing year by year, 171 million Taiwan dollars in 2011, 214 million Taiwan dollars in 2012 and 336 million Taiwan dollars in 2013 (Calculate from the Ministry of Interior National Immigration Agency). Specially, one which is named National New Immigrant Torch Project is jointly promoted by Ministry of the Interior and Ministry of Education since 2012. This project aims to extensively help immigrant and their children's learning. In addition to above-mentioned policies, Taiwan's society is likely to be more inclusive of ethnic diversity, which will bring more social support to immigrants and their descendants. For example, immigrants could be more likely to be supported by different communities, such as the support within the community, which is generated by the growing number of immigrants. In addition, immigrant children could be able to afford a more friendly environment at school, which can reduce their isolation and thus benefit their school life.

3.7 Discussion and conclusion

Trends of increasing rates of marriage separation, population ageing, and foreign-born population have triggered a global rise in the number of non-traditional households. The rapid proliferation of these family structures is eroding the prevalence of traditional two-parent family structures with wide-ranging implications for children academic performance.

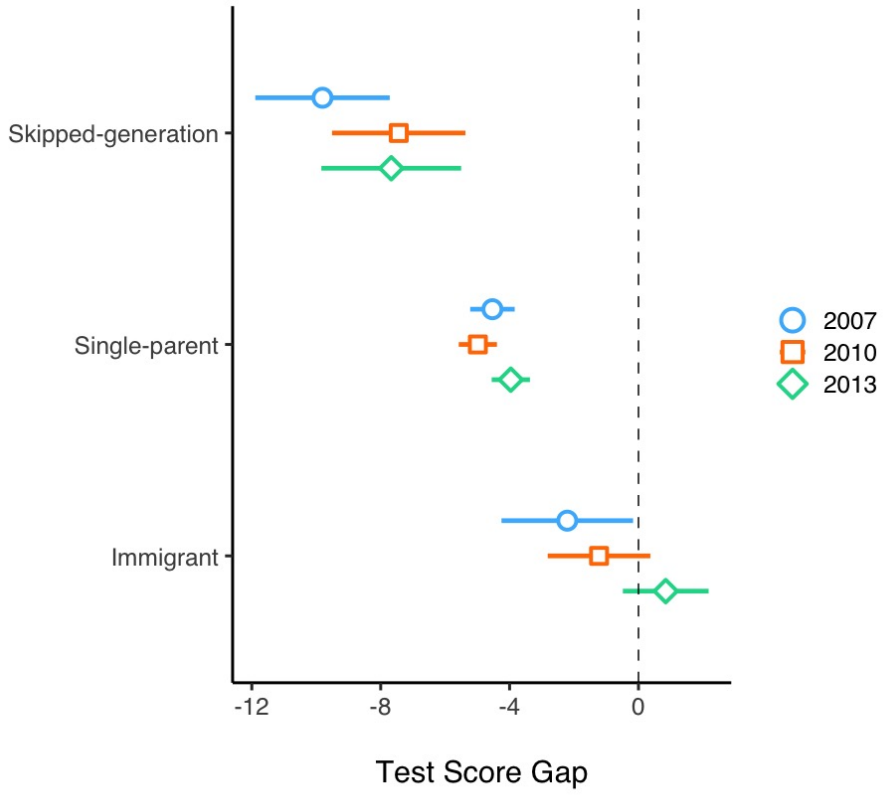


Figure 3.2: Test score gaps between each family structure and two-parent households by year

Yet, little progress has been made in understanding the association between various forms of non-traditional family structures and children school performance. This study sought to empirically assess the influence of four household structures (two-parent households, skipped-generation households, single-parent households, and immigrant households) on cognitive knowledge (measured by test scores), examining variations across disciplines and persistence over time. To this end, we used a quasi-experimental design. To reduce the influence of confounders, we used a machine learning-based PSM approach to identify comparable children from non-traditional family structures to those from two-parent families based on observed characteristics. The robustness of the empirical results is checked by implementing a traditional PSM with parametric modelling, which uses a multinomial logit model to compute propensity scores. The results are shown in the appendix of this chapter, which is similar to the results of the non-parametric modelling introduced in this study.

Firstly, our findings revealed that, overall, children from skipped-generation households are consistently the most academically disadvantaged. Children from two-parent households registered the highest academic scores while children from single-parent households tended to achieve scores of 4.7 points lower. These findings are consistent with previous studies indicating that children from less traditional family structures tend to record lower school achievements than children from two-parent households [301]. This outcome reflects financial disadvantage, lack of educational resources and limited parental involvement relating to less traditional family structures, in order to offer appropriate educational support for their children [183, 28, 380]. Children in immigrant households, however, perform as well as children in two-parent families. This may be due to the fact that immigrants in Taiwan originate primarily from Mainland china and therefore share the same mother tongue. As a result, their language barrier, which is the most important factor that hinders immigrant learning, is reduced.

This research is comparable to the results of Lin and Lu [282], which also uses TASA data to show the gap in the test results between children with native mothers and mothers of different nationalities. Children are divided into several groups according to their mother's nationality. They find the widening academic gap between native children and children with mothers from Southeast Asian countries, while the gap between children with mothers and children with mothers from Mainland china is merely small, implying the role of parents' language skills in influencing pupil's learning. However, Lin and Lu [282] compare children only with their native mothers and children with immigrant mothers, while ignoring other types. Conversely, we take into account not only native children

and immigrant children, but also children from different types of households, which leads to more fruitful discussions about the academic gap between children from different types of family structure.

Secondly, children from skipped-generation households and single-parent households perform worse than children from two-parent households across all five disciplines of cognitive knowledge in our analysis. By contrast, children from immigrant households tend to achieve similar scores in most disciplines to children from two-parent households, with the exception of Chinese and English, where they perform better in Chinese than those of two-parent families. These findings are inconsistent with existing research in industrialised western societies which indicates that children from immigrants tend to perform worse in Reading, Math and Science [152]. This contrasting finding could be traced to the fact that immigrants in Taiwan are primarily sourced from Mainland china, and hence share the same mother tongue. Language barriers, which are commonly a key factor undermining the learning abilities of immigrant children, do not represent an impediment for most immigrants in Taiwan.

Third, the poor academic performance of children from skipped-generation households and single-parent households show remarkable persistence over time. Of children from skipped-generation households and single-parent households consistently achieve scores up to 9 points lower than children from two-parent households. In contrast, children from immigrant households displayed a same level of performance as those from two-parent households since 2010. This seems to reflect the increasingly selective group of immigrant population in Taiwan. The percentage of immigrants who have at least completed university or above grew from 33.9% in 2015 to over 35.5% in 2018 (The Ministry of Interior, Department of Household Registration). Holding a higher education qualification is typically associated with higher socio-economic status which is in turn positively linked to higher educational performance and achievement [21].

Key implications emerge from our research findings. In terms of policy, our findings indicate that offering financial assistance for skipped-generation households and single-parent households is key to tackle the reproduction of socio-economic inequality. Currently financial subsidies are provided to these families through the Act of Assistance for Family in Hardship. However, the total allocated budget to the relevant subsidy packages has not increased despite the increasing number of skipped-generation and single-parent households in Taiwan. Moreover, once children living in certain family structures have relatively poor academic performance in relatively early life, government or policy makers can offer

remedial lessons or offer some methods to help children learn. Therefore, these children can stand on the same page with children from other family structures. Therefore, they can have better academic performance, which plays an important role in the success of the labour market in later life.

In terms of future research, building on a cross-sectional analysis, our findings revealed the persistence of academic disadvantage among children from skipped-generation and single-parent households and improvement in the academic performance of immigrant background children. The long-term cognitive development and future career outcomes of children from these family structures remains an under-studied area of research. In the context of increasing representation of non-traditional household structures in industrialised societies, understanding the long-term trajectory of children from these families is important to develop policy interventions that ensure inclusive and sustainable economic and social progress [279].

This research still contains some limitations. Firstly, the dataset used in this research does not document the information on family income or wealth that can better identify social-economic status. However, we alternatively use the number of stored books and whether there are 3c products at home as a proxy. Secondly, the lack of completeness of these data restricts more comprehensive research. In fact, this research evaluates the effects of the family structure on the academic performance of children in the same phase of formal learning (i.e., students in 8th grade) across three waves (2007, 2010, and 2013). However, if there were longitude data that traces every student for years, this research could be extended to assess the effects of family structure over time with a better control of heterogeneity among children. For example, with longitude data, one can use either fixed-effect or random-effect approaches to take personal heterogeneity into account in the constant term of empirical models. As a result, there are still voids to be filled in this problem, and the improvement could be achieved by building a data with more information or collecting a more comprehensive data to identify identifiable children over time.

3.8 Appendix

In order to obtain an alternative version of empirical result for this study, we additionally assume $g_k(x_i)$ of Equation (3.1) to be a logistic function. In this setting, the propensity weight is based on a parametric approach, which can be a good reference to evaluate the advantage of using a non-parametric approach introduced in previous sections. The sample weight are then computed to implement survey-weighted estimation for Equation (3.5) and Equation (3.6), and the corresponding estimates are displayed in Table 3.8 and Table 3.9. Also, Equation (3.7) is estimated to plot Figure 3.3.

The results from these two approaches do not recognise a systematic difference, while only reveal slight change on the significant level of some coefficients. First, by comparing the results of Equation (3.5) from two approaches, the gap in testing score between children from immigrant family and that from two-parent family turns to be insignificant under the parametric approach, while the result of Equation (3.6) looks similar in both approaches. Second, by examining each specific subject, the results look similar in both approaches, while a noticeable difference is that the gap in English score between children from immigrant family and that from two-parent family turns to be insignificant in parametric approach.

Lastly, the results from Equation (3.7) show a progress in children's academic performance from 2007 to 2013. In non-parametric approach, the disadvantage of children from immigrant family is significant in 2007 but then becoming insignificant in 2010 and 2013. However, in parametric approach, children from immigrant family have higher testing score than those from two-parent family in 2013.

Table 3.8: Regression coefficients of different family structures

	(1)	(2)	(3)
Skipped-generation	-11.044 ***	-8.880 ***	-8.881 ***
	(0.580)	(0.585)	(0.584)
Single-parent	-6.033 ***	-4.963 ***	-4.963 ***
	(0.216)	(0.213)	(0.213)
Immigrant	-0.855	-0.376	
	(0.486)	(0.481)	
Immigrant-one			-0.226
			(0.501)
Immigrant-two			-1.773
			(1.596)
Gender	-2.378 ***	-1.972 ***	-1.970 ***
	(0.166)	(0.164)	(0.164)
Sibling presence	-0.562	-1.051 ***	-1.050 ***
	(0.293)	(0.289)	(0.289)
Male Guardian-illiterate	-15.396 ***	-12.526 ***	-12.511 ***
	(1.072)	(1.062)	(1.063)
Male Guardian-elementary	-16.391 ***	-13.123 ***	-13.129 ***
	(0.547)	(0.547)	(0.547)
Male Guardian-junior	-14.787 ***	-12.178 ***	-12.183 ***
	(0.424)	(0.424)	(0.424)
Male Guardian-senior high	-11.386 ***	-9.651 ***	-9.653 ***
	(0.383)	(0.382)	(0.382)
Male Guardian-junior college	-4.648 ***	-3.791 ***	-3.795 ***
	(0.402)	(0.400)	(0.400)
Male Guardian-university	-3.499 ***	-3.103 ***	-3.103 ***
	(0.368)	(0.364)	(0.364)
Female Guardian-illiterate	-10.078 ***	-6.471 ***	-6.449 ***
	(1.042)	(1.021)	(1.021)
Female Guardian-elementary	-8.450 ***	-5.668 ***	-5.672 ***
	(0.650)	(0.642)	(0.642)
Female Guardian-junior	-8.801 ***	-6.155 ***	-6.156 ***
	(0.557)	(0.552)	(0.551)
Female Guardian-senior high	-5.501 ***	-3.783 ***	-3.784 ***
	(0.512)	(0.507)	(0.506)
Female Guardian-junior college	-0.953	-0.202	-0.203
	(0.522)	(0.516)	(0.516)
Female Guardian-university	-1.046 *	-0.560	-0.561
	(0.493)	(0.486)	(0.486)
Chinese-speaking	5.283 ***	4.387 ***	4.384 ***
	(0.250)	(0.246)	(0.246)
Home-computer		4.776 ***	4.774 ***
		(0.460)	(0.460)
Stored books (Medium)		6.491 ***	6.489 ***
		(0.211)	(0.211)
Stored books (High)		9.668 ***	9.667 ***
		(0.224)	(0.224)
Constant	75.989 ***	63.504 ***	63.510 ***
	(0.570)	(0.732)	(0.732)
Observation	48,184	48,101	48,101
R-square	0.184	0.225	0.225
AIC	415,615	413,008	413,009

[1] Estimates with stars are those statistically significant, where *, **, and *** respectively indicates the p-value to be smaller than 0.1, 0.05 and 0.01.
[2] Standard deviations are in parentheses.

Table 3.9: Regresion coefficients of different family structures by subject

	Chinese	English	Math	Science	Social Science
Skipped-generation	-6.546 ***	-10.746 ***	-11.628 ***	-6.640 ***	-8.505 ***
	(0.989)	(1.060)	(1.116)	(0.906)	(0.948)
Single-parent	-2.741 ***	-6.521 ***	-6.907 ***	-4.085 ***	-4.394 ***
	(0.337)	(0.412)	(0.446)	(0.341)	(0.322)
Immigrant	1.679 *	-1.206	-0.907	-0.159	-1.181
	(0.743)	(0.934)	(1.040)	(0.732)	(0.762)
Gender	-4.142 ***	-6.941 ***	0.789 *	1.042 ***	0.135
	(0.259)	(0.308)	(0.349)	(0.261)	(0.244)
Sibling presence	-0.886 *	-3.607 ***	-0.684	-0.417	0.446
	(0.445)	(0.545)	(0.595)	(0.466)	(0.444)
Male Guardian-illiterate	-11.642 ***	-20.943 ***	-12.002 ***	-7.889 ***	-9.385 ***
	(1.751)	(2.029)	(2.187)	(1.660)	(1.500)
Male Guardian-elementary	-11.711 ***	-18.456 ***	-15.556 ***	-10.841 ***	-8.745 ***
	(0.882)	(1.002)	(1.148)	(0.853)	(0.857)
Male Guardian-junior	-10.567 ***	-17.496 ***	-13.826 ***	-9.456 ***	-9.006 ***
	(0.668)	(0.749)	(0.922)	(0.680)	(0.645)
Male Guardian-senior high	-9.091 ***	-12.624 ***	-10.755 ***	-8.280 ***	-7.047 ***
	(0.603)	(0.660)	(0.831)	(0.618)	(0.580)
Male Guardian-junior college	-3.501 ***	-5.147 ***	-4.485 ***	-3.495 ***	-2.204 ***
	(0.617)	(0.680)	(0.883)	(0.658)	(0.601)
Male Guardian-university	-3.758 ***	-3.888 ***	-2.877 ***	-2.956 ***	-1.935 ***
	(0.570)	(0.607)	(0.795)	(0.601)	(0.551)
Female Guardian-illiterate	-3.949 *	-12.288 ***	-8.531 ***	-6.884 ***	-2.730
	(1.670)	(1.855)	(2.171)	(1.583)	(1.573)
Female Guardian-elementary	-4.367 ***	-12.428 ***	-5.959 ***	-6.436 ***	-0.323
	(1.011)	(1.107)	(1.365)	(1.037)	(1.002)
Female Guardian-junior	-5.041 ***	-11.474 ***	-6.605 ***	-7.183 ***	-1.848 *
	(0.845)	(0.923)	(1.181)	(0.906)	(0.863)
Female Guardian-senior high	-2.045 **	-7.139 ***	-4.365 ***	-4.552 ***	-1.603 *
	(0.768)	(0.818)	(1.090)	(0.843)	(0.797)
Female Guardian-junior college	0.402	-2.386 **	-0.049	-0.441	0.857
	(0.783)	(0.831)	(1.115)	(0.863)	(0.805)
Female Guardian-university	0.011	-2.750 ***	-0.796	-0.420	0.459
	(0.734)	(0.774)	(1.051)	(0.815)	(0.762)
Chinese-speaking	4.300 ***	4.722 ***	5.493 ***	4.903 ***	2.551 ***
	(0.404)	(0.467)	(0.508)	(0.387)	(0.375)
Home-computer	4.513 ***	7.941 ***	6.912 ***	3.476 ***	1.480 *
	(0.796)	(0.849)	(0.931)	(0.717)	(0.700)
Stored books (Medium)	5.961 ***	7.521 ***	7.860 ***	5.612 ***	5.293 ***
	(0.333)	(0.404)	(0.450)	(0.332)	(0.313)
Stored books (High)	8.681 ***	11.111 ***	11.773 ***	8.910 ***	7.848 ***
	(0.351)	(0.423)	(0.479)	(0.358)	(0.329)
Constant	64.073 ***	74.161 ***	56.273 ***	57.822 ***	65.040 ***
	(1.202)	(1.308)	(1.491)	(1.171)	(1.139)
Observation	19,479	18,938	18,781	19,027	18,867
R-square	0.184	0.289	0.189	0.187	0.144
AIC	167,360	168,891	172,203	163,632	159,395

[1] Estimates with stars are those statistically significant, where *, **, and *** respectively indicates the p-value to be smaller than 0.1, 0.05 and 0.01.
[2] Standard deviations are in parentheses.

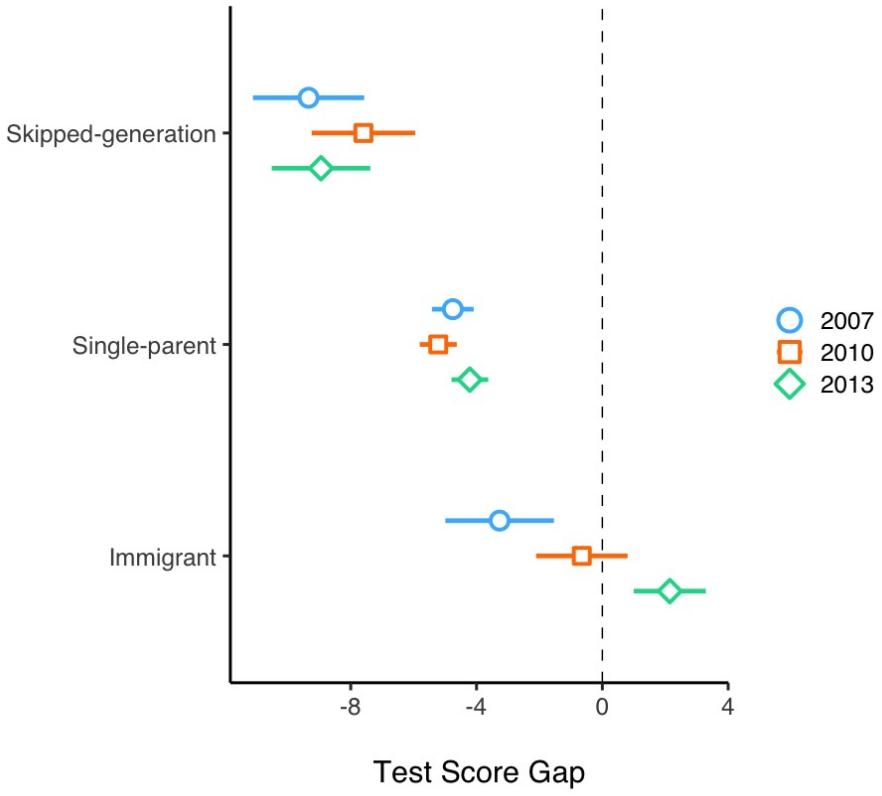


Figure 3.3: Test score gaps between each family structure and two-parent households by year

Chapter 4

The Impact of Immigrant Mother's Nationality on Children's Educational Performance

Abstract

Chapter 3 evaluates the academic performance of children under different family structures (two-parent, single-parent, immigrant, skipped-generation families). Children from two-parent families and those from skipped-generation families respectively perform the best and the worst among four kinds of family structure. Children in immigrant families do not have a significant test score difference with children in two-parent families, while Children in single-parent families perform worse than children in two-parent families.

Immigration has always faced an upward trend. The advancement in transportation and telecommunication industries in recent years has made the world a smaller place, thereby further contributing to the accelerated growth rate of immigrants in any country. In addition to immigration making an impact on the lives of the immigrants, it has been suspected to also influence the children of the immigrant parent. Moreover, Taiwan shares the totally different immigrant picture than other countries- more than the Taiwanese brides, the Taiwanese grooms sought brides from foreign countries. From 2001 to 2020, the number of female immigrants to Taiwan is 1.5 to 2.5 times the number of male immigrants to Taiwan (Department of Household Registration, M.O.I). Besides, the transnational marriage is prevail so that numerous matchmaking agencies emerged to utilise the opportunity and offer their services. These phenomena motivate us to go deep into the difference between children of native mothers and children of immigrant mothers in Taiwan. In order to purely assess the influence of mother on children, father's influence on children must be excluded. Therefore, children from single-parent families are our observations in Chapter 4.

There are two main and important reasons that motivate us to extend the analysis to Chapter 4. First, we get into the families of single parents, with a focus on the families of single mothers. There are fundamental differences between native single and immigrant single mothers. In Taiwan, for example, most foreign brides have a lower social-economic status than native brides and lower incomes, because there is an entry barrier that prevents them from getting into employment. Furthermore, it is mainly men with lower social-economic status who are looking for foreign brides in Taiwan. So when these women divorce, the alimony they get is relatively low, or even without alimony. Moreover, most foreign brides are still the main economic supporter of their original families, which rely largely and continuously on the support of these brides even after marriage for years. As a result, divorce would be more stressful for foreign brides than for native brides. Foreign brides and native brides faced different pressures and difficulties after divorce. Therefore, it is necessary to examine how children's development varies according to their mothers' nationality.

Second, in Taiwan, the government places a substantial emphasis on subsidies and

policies for single-parent families, and aims to keep their children on the same page as other children. As most single mothers are disadvantaged, they need material and non-material support from the government. This research can give the government an enlightenment and a basis for policy-making. When the government budget is limited, the government can allocate the resources well so that the groups in need can be identified and targeted in the subsidy policy. Therefore, the topics covered in Chapter 4 are valuable and necessary for the Taiwanese government.

Chapter 4 aims to evaluate the test score differences between children with single mothers of different nationalities and native single mothers. Our results show that children with immigrant single mothers are likely to perform worse, with the exception of children with immigrant single mothers from China. Children with mothers from Mainland China will perform better than children with native mothers. This may be because the mother of Mainland China shares the same mother language as Taiwan. Therefore, mothers are likely to involve the learning process of children. Our empirical findings may suggest that remedial teaching (or equivalent preference policy) for children with single mothers from southeast Asia may be required to create a fair learning environment, and the policy should take into account the nationality of mothers.

4.1 Introduction

Immigration has always faced an upward trend. The advancement in transportation and telecommunication industries in recent years has made the world a smaller place, thereby further contributing to the accelerated growth rate of immigrants in any country [399]. Various factors implement the individuals' decision to migrate to another place. These factors include business, marriage, war, the standard of living, and many more. In addition to immigration making an impact on the lives of the immigrants, it has been suspected to also influence the second generation of the immigrant parent. Tienda and Haskins [403] say that in the case of marriage between a native and an immigrant, there exist parents of two different cultures, making an impact on the academic progress of the children.

Taiwan has been considered for the current study, as it is one of such economy that has immigrant-friendly laws. Moreover, it shares different immigrant trend as other countries in terms of purpose of immigrant to Taiwan and the origin of immigrants. Immigration into Taiwan has been increasing since the 1990s when the country decided to take-in low skilled immigrants and ensure an inflow of foreign contract workers to boost its economic growth. According to the statistics from the Ministry of Interior's National Immigration Agency, as of 2020, the country is home to over 770,000 foreign residents, where more than 90 percent of the immigrants are from the Southeast Asian countries such as Philippines, Vietnam and Indonesia. As mentioned earlier, there exist various reasons for individuals from other countries to migrate to Taiwan. Initially, up until the 1980s, war served as the primary reason for individuals to migrate to Taiwan and take refugee. However, as of now, business and marriage have succeeded in becoming a significant reason for the concentration of immigration in Taiwan. In 2020, 80.5% of foreign residents (who are not yet acquiring the nationality) in Taiwan are foreign labour, and 8.1% are foreign spouses. Between the two reasons, Chen et al. [88] say that marriage holds significant importance since in some cases it is conducted to support the business. The imbalance in demographic development is also a contributing factor to the upward demand of foreign brides for men in Taiwan. Yang and Liu [439] suggest that the imbalance in gender ratio leads to the shortage of women in Taiwan, so that men of marriageable age are unlikely to find native spouses. From the prospect of males in Taiwan, because some of them find it difficult to marry local females, they turn to seek forming family with foreign females who are mainly from Southeast Asia and Mainland china [392], which thus bring to a large scale of marriage immigrants into Taiwan.

Most marriage migrants decide to marry Taiwanese men because they hope to escape poverty and turbulence in their home countries, intensified by capitalist globalisation [226]. Taiwanese males looking for foreign brides from less developed areas usually share similar characteristics. They are likely to be lacking in masculinity. Besides, demand for free or unpaid work is also a reason for men to do so [408]. The above-mentioned evolution constructs an overly female-integration inflow to Taiwan. In particular, the National Immigration Agency of Taiwan reported 53.9 percent of females among foreign residents in 2019, while the United Nations Immigration Report of the United Nations only claims 47.91 percent and 41.54 percent for the proportion of female immigrants in the world and in Asia [324]. This comparison furthers characterising the uniqueness of Taiwan from other countries in terms of female immigrants and the issue of households that involve foreign brides. Besides, Tseng [408] founded that owing to the frequent number of transnational marriages between 2000 and 2010, numerous matchmaking agencies emerged to utilise the opportunity and offer their services. More than the Taiwanese brides, the Taiwanese grooms sought brides from foreign countries. In the last decade, the number of foreign female spouses overtook foreign male spouses by a minimum of 7 times. For instance, in 2007, the number of foreign male spouses stood at 3,141 in Taiwan while the number of foreign female spouses stood at 21,559 [70]. The difference has led to an increase in Taiwanese children with immigrant mothers. They are also called New-Taiwanese offspring [84]. Moreover, immigrant brides report on average a lower level of happiness [278]. Besides, intermarriage couples are likely to end up divorced than both native couples [341]. The proportion of divorced women who are not native born remains high recently. According to the Ministry of the Interior in Taiwan, despite the fact that female immigrants account for only 12.53% of all divorced women in 2020, the long-term proportion of divorced immigrant females accounts for about 20% of the total divorced women in recent years.[1]

The above phenomenon shows together the unique immigrant trend in Taiwan. It shows the need to investigate the impact of an immigrant single mother on children's academic performance. Moreover, Plomin and Daniel (1987) found that children growing in the same family are likely to have different environmental effects on children and lead to different behaviours. The extent to which children are affected by the external environment varies from person to person. Therefore, in our study, we also evaluate whether children with

[1]The long-term proportion is measured by a 10-year moving average, where the values are 20.15%, 20.23%, 20.09%, 19.60%, and 18.45% respectively from 2016 to 2020.

different score distributions are affected by the nationality of their mother to a different extent.

4.1.1 Research gap

With academic performance as their primary focus, earlier researches have already pointed out the differences in the performances of the New-Taiwanese Offspring and the native children. For instance, some studies focused on the Chinese immigrants in Taiwan and stated that the performance of their New-Taiwanese Offspring remains almost the same as that of the native children [94, 227]. Similarly, various other studies concentrated on different ethnicity of the immigrants and revealed either a comparatively poor or a high performance between the New-Taiwanese Offspring and the native children [284, 268]. As the focus of their studies falls on specific immigrant offspring, it becomes difficult to come up with strategies that would benefit all the New-Taiwanese Offspring. There also exist certain studies that concentrate on New-Taiwanese Offspring collectively, but their focus group always includes a native father or immigrant father as the influential figure [438, 165, 229]. With the growth rate of immigrant brides growing significantly and the persistently high rate of immigrant women among divorced women, there is a need to take into account the impact of immigrant mothers on the academic performance of the New Taiwanese offspring. Although some previous studies have examined the discrepancy in academic performance of children from households with mothers from different countries (e.g., Lin and Lu [282]). The inferred result in Lin and Lu [282] that children in families with immigrant mothers are likely to perform worse may not be the purest impact of immigrant mothers, as the families focused in their study include the presence of fathers. Therefore, the disadvantaged performance of children may not be entirely due to immigrant mothers. Children are likely to be affected by fathers. In this regard, current research would stand out from other literary works on New-Taiwanese offspring, as it will focus on children with immigrant single mothers.

The reasons why we examine single-mother families of different nationalities rather than single-parent families of different nationalities are as follows: first, the transnational marriage situation in Taiwan is different from Western countries. In Taiwan, men with a lower socio-economic status or less educated are more likely to seek foreign wives. Conversely, in Western countries (e.g., the United Kingdom), it is more likely that men with a higher socio-economic status seek wives of foreign nationality. The reasons for Taiwan's

situation above are that Taiwan's women labour force participation has increased and their education is much higher than before. Many highly educated women are unwilling to marry low-educated men, so these men turn to find foreign brides. Moreover, marriage, the creation of a family and descendants in Taiwanese society are issues of traditional importance, and this has encouraged stigmatised men, including disabled men, to choose intercultural marriage [88]. Thus, the number of Taiwanese men with immigrant wives is much higher than the number of Taiwanese women with immigrant husbands. Therefore, this research focuses on families with single mother across different nationalities, rather than those with single father across different nationalities.

The current study offers a deep understanding of how various factors related to immigration affects the academic performances of children of the immigrated. The current study breaks the base assumption in many of the other studies that state academic performance of children relates to the nationality of the father [420, 440, 278]. The current study will evaluate the academic performances of New-Taiwanese Offspring with immigrant single-mother against the academic performances of children with native parents. The current study would consider only the common parental variables that influence a child's education while making the evaluation. By doing so, the study could better expose the issues concerning immigration and children's education. The evaluation would assist in identifying variations in the factors that affects the academic performances of children with native parents and children with immigrant single-mother of different nationalities. The government could make use of the recognised variations to draw immigrant policies that would provide a fair advantage to the children with immigrant single-mother. It would further ensure effective integration of the children despite the variations in their family background.

4.1.2 Aims and objectives

The current study primarily aims at establishing the relationship between the nationality of a mother and the academic performance of the New-Taiwanese Offspring. The study also includes a secondary aim that attempts to find out whether or not children in different performance distribution are affected to the same extent by the mother's nationality and other factors. The objectives of the study that will assist in accomplishing the aim of the current study are,

1. To identify the factors that would affect the academic performance of children of

single mothers

2. To estimate the influence of the country of birth of the mother on the academic performance of the children

3. To identify score gaps for children with mothers of different nationalities in all score quantiles

4.2 Literature review

4.2.1 Background information on foreign spouses in Taiwan

The country of Taiwan is located in the eastern part of Asia and isolated by the Western Pacific Ocean from Mainland china. The country also goes by the name Formosa that addressed the beauty of the island in Portugal language. During the last decade, between 2001 and 2010, the population of the country rose to 23 Million. The population mainly consists of people whose ancestors migrated from Mainland china during the earlier period. They heavily contribute to the establishment of the country, and forms around 86% of the total population. About 12% of the population include Mainland Chinese who migrated during the Chinese civil war that started in 1927 and went on for 24 years [287]. Only the remaining 2% of the population consists of aborigines of the early Taiwanese [164]. Asides from being a majority among the immigrant population, the immigrant brides hold a significant share in the total population of Taiwan as well. In a statistical survey carried on by Capps et al. [77] concerning the immigrant population, it was realised that the immigrant brides form about 1.3% of the total population of Taiwan. The number stands almost equal to that of the aborigines of the early Taiwanese. During the year 1949, at the time of the Civil War in China, the Communist Party of China took over the government in Mainland china. Upon losing the government in Mainland china, the Republic of China re-established a government in Taiwan. From thereon, until 1987 numerous restrictions were placed in both Taiwan and Mainland china, thus limiting any communication between the two countries. Campbell et al. [74] has stated that owing to the conflicts between the governments, no official channels of communications could be recognised and utilised during that period. From 1987 onwards, the government of Taiwan offered permission for the Taiwanese to visit their relatives in Mainland china. However, it gave rise to certain social issues. The problems include those of bigamies and inheritances. For instance,

people were married more than one time and it led to questions such as whose offspring inherits the wealth of the parent with multiple spouses [103, 108].

To overcome the problems, the government of Taiwan passed an act in 1992 concerning the relationship between the people in Taiwan and the people who resided in Mainland China [97]. As per the act, the individuals in Mainland China who had married individuals in Taiwan would have the right to take residence in Taiwan. Bélanger and Wang [72] say that the act played a vital role in increasing the rate of immigrants in Taiwan. The reason is that in the decade following the enactment of the act, the number of immigrant brides in Taiwan faced a considerable increase. According to the Ministry of Interior, the proportion of immigrant brides to all brides is only 14% in 1998, and it further doubles to 28% in 2003. It shows that the immigrant Mainland Chinese mother in Taiwan takes a considerable portion of the total number of mothers in Taiwan as of now. Furthermore, Chen [90] and Bélanger et al. [71] have further stated that asides from Mainland China, the Taiwanese looked for brides from other foreign nations such as the Philippines and Vietnam. Moreover, there are some background and reasons that stimulate a significant inflow of marriages into Taiwan. Firstly, Taiwanese men have less chance of marrying native women in recent decades. Taiwanese women are likely to marry men who are more educated and paid higher than themselves [72], and this pattern has been shown to explain a high single rate of native women, as gender participation in education and labour markets is more equal [241, 406]. Second, there are agencies that organise trips for men to travel abroad to find potential brides, mainly in Southeast Asia and Mainland China. Women from these areas are attractive to Taiwanese males in terms of physical and mental characteristics, such as youthful, pretty, virginal, diligent, submissive, and obedient [72]. By marrying deferential women from these areas, men can also confirm their masculinity [421].

On the other hand, the issues surrounding marriages also had an increase proportionate to the marriages of immigrants. According to Hsia [225], a primary issue was that people engaged in fake marriages to gain entry into the country. The government of Taiwan again intervened in the issues by enacting another act in 2004 that provided the government with a right to interviewing future brides before permitting them to a Taiwanese individual. Though the percentage of immigrant brides fluctuated a little, it did not incur any major fall during the year [163, 445, 381]. According to the Ministry of Interior, foreign brides account for 16% among all brides in 2009. Liang et al. [280] has revealed that the continuous upward trend in transnational marriages during the previous two decades had heavily contributed

to the growth of children with immigrant mothers or the New Taiwanese Offspring. As the Ministry of the Interior reported, the ratio of new Taiwanese offspring among newborn babies reached 6.06% in 2020. The ratio continues to fluctuate with respect to the changes in the ratio of immigrant brides. According to statistics reported by the Ministry of Education, the new Taiwanese offspring have reached a peak in terms of accounting for 12.2% of elementary school pupils in the 2013-2014 semester from a low level in the 2008-2009 semester (6.7%), although they have been downward since then. However, it is still higher than 10% in the semester 2016-2017 and 7.8% in the semester 2019-2020.[2] Through the literary works, one could say that the percentage of partial immigrant families could be split into three major categories based on the country they are from; Southeast Asia mother families, Mainland China mother families, and other immigrant mother families. The other immigrant families are comprised of immigrant mothers from India, Japan, Europe, and the US who contributes to a small portion of the total immigrants in Taiwan [85].

4.2.2 Children's academic performance

Cognitive development theory

Jean Piaget, a re-known constructivist, and interactionist brought forward the theory of cognitive development. Jean explains the significance of the 'constructive role of experience' through a child's interaction with age mates and family members. The theory assumes that children are active learners and are constantly in a quest to find information that matches their cognitive constructions; their perception of the real world [346]. Children also attempt to understand their environment and the realities within them through external constructions. Prior and Gerard [351] explain that children are continuously revising and accommodating their cognitive constructions as they undergo new experiences. Within a child's environment are people and the general society. Social interactions thus influence a child's cognitive development.

Children tend to be proactive in assimilating, learning, and accommodating their perceptions as well as new concepts if they interact actively with other people and the environment. Therefore, children need opportunities to actively interact with the surrounding to ensure they learn as best as they can. Parents thus become critical components of their

[2] In Taiwan, a semester starts from September of a year and ends at June of the next year. For example, the semester 2013-2014 indicates the time between September 2013 and June 2014.

children's environment since they interact regularly. Parents can actively engage in their children's learning process through activities such as interactive assignments. Piaget's theory supports the postulation that a child's development and prosperity rely on the parent's involvement.

Academic performance of children in immigrant families

Earlier studies in the academic performances of the immigrant children have demonstrated varying levels of performances between the native children and the immigrant children. A common perception adopted in many of the studies is that the performance of the immigrant children should not vary from that of the native children. Fuligni [170] believes that by socialising and adapting themselves with other children, the immigrant children overcome the academic gap that exists between them and the children with native families. While conducting a study on immigrant children in the US, Hernandez et al. [213] has stated in the agreement that the immigrant children sometimes offer higher educational performance than that of the native children. Contradicting their statement, Coll and Marks [106] argues that the growth of immigrant children in educational institutions could be intervened by various drawbacks in relation to the position. This includes the tradition of following an ethnic hierarchy. As per their study, the immigrant children in families that have positional drawbacks faces a difficult time meeting up with the performances of the native children. Shields and Behrman [380] agree with the latter statement by further pointing to the social backgrounds of the children's immigrant families which discourages or demotivates the immigrant children from aiming for higher performances in their academics or education.

There are several factors that influence the academic performance of immigrant children. According to Considine and Zappalà [109], difference in nationality means a difference in the cultures adapted by the individuals of those countries. In this regard, the cultural values and languages followed by the immigrant parents are likely to influence the success of their children in fulfilling the academic expectations in foreign countries. As part of the cultural value, Leidy et al. [273] has placed importance on the size of the family. Leidy et al. [273] believes that while the US culture encourages small size family, in countries like China, people believe in joint family. Such beliefs are expected to make an impact on the learning styles of children. In agreement, Carol et al. [81] has stated that when the size of the family increases, the focus of the parents becomes much more diversified, resulting in

less supervised children, who scores fewer grades in school.

On the other hand, Karoly and Gonzalez [246] believes that the educational qualifications of the parents affect the academic performances of immigrant children. Educated parents could offer educational help to their children while at home, thus enabling them to increase their academic performance [35].

In the meantime, De Feyter and Winsler [117] highlighted language skills as a significant nationality variant and found that the ability to communicate becomes a significant problem for children with a migrant background. Tienda and Haskins [403] identify language as one of the basic requirements of children for thriving academic performance. While the native families pass on the required language skills to their children for effective communication, the families with immigrant spouses could not do so as their language skills differ from that of the environment they currently live in [335]. Despite the varying level of importance placed by different researchers, one cannot completely deny the influence of these those factors in distinctly influencing the academic performances of native children and immigrant children. In this regard, the current study would consider all factors for achieving its aims and objectives.

Academic performance of children in single-mother families

The prevalence of divorce could lead to a considerable rise in single-parent family. The dissolution of marriage disrupts the functioning of a normal family and generates harmful effects on children, such as consequences of negative emotion, cognitive, and behavior (see [215]).

According to Furstenberg et al. [157], fewer fathers retain custody of their children, and this type of father usually involves little in child care, leaving the majority of the responsibility for raising their children to the mother. Meanwhile, divorce has been proven to have a disruptive impact on the economic and social sides of mother-led households and their children [30, 31, 168, 78]. Children living in such family may receive less supervision and parental support, and could be raised by a single mother under substantial pressure [157].

There have been several research that documented the educational difficulties of children from single-parent families [47, 199, 299, 217]. There is also evidence that children from single-parent families underperform their peers from two-parent families (e.g., [304, 317]). There are various explanations for this phenomenon. Moynihan et al. [315]

suggest that poverty deals with the lower academic performance of offspring from single mothers. In addition to the perspective of economic deprivation, Dornbusch et al. [125] and Biller [44] use alternative perspectives to explain this phenomenon. They believe that the weaker structure of parental authority in single-parent families is the reason why children from single-parent families have poor school performance.

Academic performance of children in immigrant single-mother families

The academic performance of children in immigrant or single-parent families is well documented in previous studies. The barriers faced by immigrant and single-mother families are also discussed above. However, studies seldom emphasise the academic performance of children living in immigrant single mother families. Children in immigrant single-mother families are likely to face barriers faced by immigrant families and have problems faced by single-mother families. The obstacles they may face are rarely discussed in previous studies.

O'Mahony et al. [339] carried on a study on immigrant single parenting and founded that socioeconomic status played a vital role in the academic performance of children. Children with high socio-economic backgrounds were able to proceed with confidence while children with poor backgrounds tend to have a difficult time overcoming their fear [180]. In another study, Andersson et al. [13] further founded that children with poor socioeconomic backgrounds face difficulty in gaining friends especially in an environment filled with children of high socioeconomic status. The nationality of the immigrant plays a role in deciding the socioeconomic status, since immigrants into Taiwan come from war affected countries such as Vietnam. As such, their socioeconomic status remains low.

The relationship between parent's education attainment and children's academic performance is well-documented. Kulu and González-Ferrer [262] believe that even in immigrant families with single-mother if the parent is educated, they could assist the family by being employed in a good company. It may also allow them to spend some time with their children, thus coming to an understanding of their wants and needs. An educated individual could better understand their children and help them with their academic troubles [281].

In addition, among several research that investigated how mother's nationality plays a role in the academic performance of children from immigrant families, Lin and Lu [282] is particularly worthy of comparison to this study. Lin and Lu [282] investigate the impact of mother's nationality on the academic performance of children in two-parent families.

Their results show that there exist test score differentials between children with immigrant mothers and children with native mothers. These disadvantages cannot be fully explained by the nationality of the mother, as these children are in two-parent families and the influence of father on children can be taken into account. It is unlikely that children are affected exclusively by mothers without being influenced by fathers, so the conclusion of Lin and Lu [282] would somehow be mixed with unknown effects from the father side. However, the influence of the father is excluded by treating the children of single-mother families as observations in this research, which is conceptually a better way to assess the pure effect of the mother's nationality on children's academic performance.

4.3 Data and statistical method

4.3.1 Data source

This research uses a data set from the Taiwan Assessment of Student Achievement (TASA), a survey conducted by the National Academy for Educational Research Preparatory Office, to investigate the impact of mother's nationality on the academic performance of children from single-mother families in Taiwan. TASA uses a two-stage stratified sampling design to determine the school and the children to take the survey. In the first stage, the sampling units are schools, which are determined by information such as district size and school size. Schools are sampled systematically with probabilities proportional to size. Then, the second-stage sample consists of classes drawn from the sampled schools with a random sampling method [441], and the students in the sampled classes would take the assessment. More detailed information related to the survey design, such as assessment framework, performance standards, scoring rubrics, and sample items or tasks are available online.[3]

Surveyed children in TASA are covered in 4th, 6th, 8th and 11th grade (see Figure 4.1). The median age for students within these groups is 10, 12, 14, and 17 respectively. It assesses the academic achievement of children in the Taiwanese national curriculum. The evaluation is conducted in all 23 counties of Taiwan at primary and secondary schools. TASA focuses on five major subjects at school (Chinese, English, Mathematics, Science and Social Science). Each child will be randomly assigned to take an exam in two of five school subjects. There would thus be 10 possible combinations for the examined subjects: Chinese and English, Chinese and Math, Chinese and Science, Chinese and Social Science, English

[3]For more details, please refer to: http://tasa.naer.edu.tw/.

and Math, English and Science, English and Social science, Math and Science, Math and Social Science, Science and Social Science. However, as an exception, children in the 4th grade will not be assigned to take the English and Social Science test. Children must also complete a questionnaire that covers personal information such as gender, number of siblings, family structure and family background. This includes assessing their academic performance. However, the questionnaire doesn't include information about the location of the school, the characteristics of the school and the classroom, so the impact of these factors can not be estimated. Nevertheless, spatial socio-economic disparities between schools and neighbourhoods in Taiwan are small. Similarly, the results of the Program for International Student Assessment (PISA) suggest that socio-economic inequalities between urban and non-urban schools in Taiwan are relatively low compared to other OECD Asian countries [149]. Accordingly, the impact of residential and school factors on children's economic performance can be expected to be smaller than individual and household attributes, in line with the findings on the small interpersonal socio-economic inequalities in countries, like Australia [364].

Table 4.1 shows the detailed timetable for the TASA assessment. In this study, eighth-graders from 2007, 2010 and 2013 became observations of research for two reasons. First, the students in this grade are about to finish compulsory education in Taiwan. Secondly, success in junior school or not influences the future study plan of the pupils, such as the choice between studying in high school or vocational school or a drop out. Furthermore, the reason why the 2006 TASA is not used is the lack of detailed information on family structures that may coincide with those in later periods of the survey.

Measure of academic performance

To measure academic performance, we use the test results from the TASA exam. TASA measures academic performance of students through test scores in variant subjects. Test results are usually used to assess children's academic performance in literature (see [116]). We construct a variable for the test score by calculating the ratio of the correctly answered number of questions to the total number of questions and then multiplying it by 100. The score ranges from 0 to 100, with a score of 80 indicating that 40 out of 50 questions were answered correctly. It is quite prevalent to use 100-point scale in grading system in Taiwan.

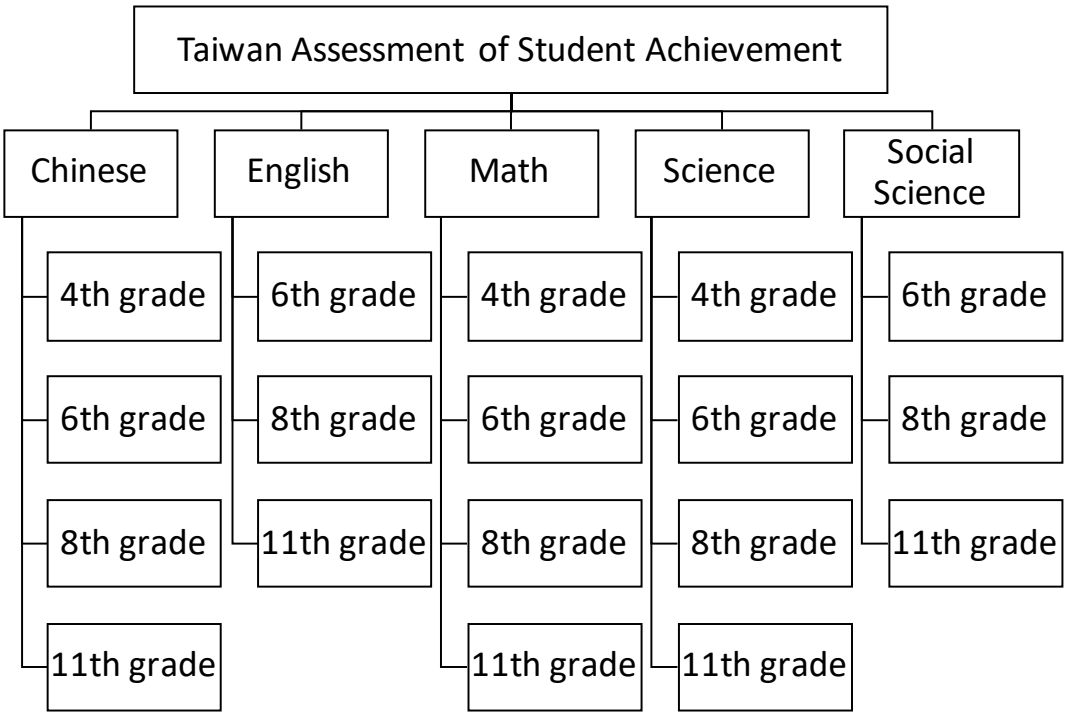


Figure 4.1: The structure of Taiwan Assessment of Student Achievement

Source: from Figure 3.1.

Table 4.1: Timetable for Taiwan Assessment of Student Achievement

Year	Term	Education Level			
		4th	6th	8th	11th
2005	1st	Pilot (2006)	Pilot (2006)	Pilot (2006)	Pilot (2006)
	2nd	-	Formal (3)	-	-
2006	1st	Pilot (2007)	Pilot (2007)	Pilot (2007)	Pilot (2007)
	2nd	Formal (4)	Formal (5)	Formal (5)	Formal (5)
2007	1st	Data analysis	Data analysis	Data analysis	Data analysis
	2nd	Formal (4)	Formal (5)	Formal (5)	Formal (5)
2008	1st	Pilot (2009)	Pilot (2009)	-	-
	2nd	Data analysis	Data analysis	Data analysis	Data analysis
2009	1st	Data analysis	Data analysis	Pilot (2010)	-
	2nd	Formal (4)	Formal (5)	-	-
2010	1st	-	-	Data analysis	Pilot (2011)
	2nd	-	-	Formal (5)	-
2011	1st	Pilot (2012)	Pilot (2012)	-	Data analysis
	2nd	-	-	-	Formal (5)
2012	1st	Data analysis	Data analysis	Pilot (2013)	-
	2nd	Formal (3)	Formal (5)	-	-
2013	1st	-	-	Data analysis	Pilot (2014)
	2nd	-	-	Formal (5)	-
2014	1st	Pilot (2015)	Pilot (2015)	-	Data analysis
	2nd	-	-	-	Formal (5)
2015	1st	Data analysis	Data analysis	Pilot (2016)	-
	2nd	Formal (3)	Formal (5)	-	-
2016	1st	-	-	Data analysis	Pilot (2017)
	2nd	-	-	Formal (5)	-
2017	1st	Pilot (2018)	Pilot (2018)	-	Data analysis
	2nd	-	-	-	Formal (5)

[1] Pilot (2006) indicates the pilot test for 2006. Formal (3) indicates the formal test including three subjects such as Chinese, Math and Science. Formal (4) indicates the formal test including four subjects such as Chinese, English, Math and Science. Formal (5) indicates the formal test including five subjects such as Chinese, English, Math, Science and Social science.

[2] Sources: Taiwan Assessment of Student Achievement for 2005-2017.

Definition of family structures

We have defined two categories of family structures: two-parent and single-mother households. Two-parent households included a native-born couple and their biological, step- and adoptive / foster children. Single-mother households comprised mother with child(ren). To measure the academic performance of children with mothers from different countries of birth, single-mother households are divided into two main categories based on whether or not the mother is native, such as native single-mother households and immigrant single-mother households. Besides, immigrant single-mother households are further divided into the following categories according to the mother's country of origin: (a) Mother who was born in Taiwan (b) Mother who came from Southeast Asian including Vietnam, Indonesia, Thailand, Philippines, Malaysia, Cambodia and Myanmar (c) Mother who came from Mainland China, Hong Kong and Macao (d) Mother who came from other developed countries such as Singapore, Japan, USA, Canada and South Korea.[4] Although Singapore is geographically Southeast Asian, it is included in (d) rather than (b) because, when researchers discuss many issues involving Southeast Asian spouses in Taiwan, it usually refers to countries in Southeast Asian, and economic development lags behind Taiwan [437].

4.3.2 Methodology

This section consists of two parts. The average influence of the mother's country of birth on the academic performance of the children is assessed in the first part by the regression analysis. Furthermore, different children may react differently to similar experiences. Thus, even mothers of the same nationality can have different effects from children with different educational achievements. The second part therefore aims to assess whether children of different academic performance is influenced differently by the nationality of the mother with the help of quantile regression analysis.

Regression analysis

[4]In this study, (a) is described as 'native,' (b) as 'Southeast Asia', (c) as 'Mainland China' and (d) as 'other immigrants'.

We estimate two sets of regression models by using the OLS approach.[5] The first set of regression models evaluates the academic gap between the children of native, immigrant single-mother households and those of two-parent households. The equation is as follow:

$$\bar{Y_i} = \alpha_1 + \beta_{11} Native_i + \beta_{12} Immigrants_i + \gamma_1 C_i + \sigma_1 S_i + \mu_i \tag{4.1}$$

where i denotes individual children; $\bar{Y_i}$ represents the overall average test score of an individual i across the two disciplines for which examination was undertaken; $Native$ and $Immigrants$ are respectively the dummy variable for native single-mother households and for immigrant single-mother households including Southeast Asia, Mainland China and other immigrant. Under this setting, the children from two-parent household (with parents who are both native) are the reference group, while those from single-mother families are treatment groups. C is a vector of variables capturing children's individual characteristics, including gender and number of siblings. S is a vector of variables capturing children's family background, specifically their mother's education level, language used at home, availability of computers and books at home. μ_i is the random error terms. For the detailed description of variables, please refer to Table 4.2.

Furthermore, due to the fact that the culture and used language of Mainland China and Taiwan are closely related, Chuang et al. [97] examine the employment status and choice of employment sectors of foreign spouses from Southeast Asian and Mainland China in Taiwan. They found out that the two groups of foreign spouses behave differently in terms of their labour market activities. This motivates us to further separate the immigrants dummy variables '$Immigrants$' into Mainland China (MC), Southeast Asia (SEA), other immigrant (Oth), and native ($Native$). Under this setting, children from two-parent families are also controlled groups, while treatment groups have become much diversified to take into account the potential heterogeneity among children, with single-parents from different countries.

[5] If the observations in a certain treatment are infrequent, the causal inference obtained by using propensity score matching (PSM) or propensity score weighting (PSW) may be biased [193]. In our analysis, one of the family types accounts for only 36 observations (i.e., sample size accounts for only 0.07% of whole sample), which is almost a case of a small sample in statistical inference. Moreover, a non-parametric approach usually requires a larger sample size to perform its advantage better than usual parametric approaches. As such, we use a traditional regression mathod to assess the desired effect.

Table 4.2: Description of variables

Variables	Description of Variables
Dependent Variable	
Average Test Score_i	Overall average test score of an individual i across the two disciplines for which examination was undertaken; from 1 to 100 points.
Independent Variables	
Family Structure	
Two-parent (Baseline)	1 for children grew up in two-parent families; 0 otherwise.
Native	1 for children grew up in native single-mother families; 0 otherwise.
Southeast Asia	1 for children grew up in Southeast Asia Single-mother Families; 0 otherwise.
Mainland China	1 for children grew up in Mainland China Single-mother Families; 0 otherwise.
Other Immigrant	1 for children grew up in Other immigrant Single-mother Families; 0 otherwise.
Personal and Family Background	
Gender	1 for male, 0 for female (Baseline).
Siblings	1 for sibling presence, 0 for the only child at home (Baseline).
Male guardian's education level	7 categorise: illiterate, complete elementary school, complete junior school, complete senior high school, complete junior college, complete university, complete graduate school or above (Baseline).
Female guardian's education level	7 categorise: illiterate, complete elementary school, complete junior school, complete senior high school, complete junior college, complete university, complete graduate school or above (Baseline).
Home computer	1 for at least a computer at home, 0 for no computer at home (Baseline).
Stored books	3 categorise: low (lower than 25 books- Baseline), medium (26 books to 100 books), high (more than 100 books)
Chinese-speaking	1 for Chinese-speaking households, 0 for non-Chinese speaking households (Baseline).

$$\begin{aligned}\bar{Y}_i =& \alpha_2 + \beta_{21} Native_i + \beta_{22} MC_i + \beta_{23} SEA_i + \beta_{24} Oth_i \\ &+ \gamma_2 C_i + \sigma_2 S_i + \nu_i \end{aligned} \tag{4.2}$$

where the ν_i denotes the error term.

Quantile regression analysis

The Ordinary Least Square (OLS) analysis is useful in explaining the impact of the explanatory variables used in the study such as nationality of mother in single-mother household, children's gender, mother's education qualification, number of siblings at home, the total number of stored books, the presence of computer and whether or not use Chinese at home. The impact of these explanatory variables needs to be estimated based on the conditional means defined with the dependent variable - children's test scores [254]. This approach here mainly assumes the distribution of the marginal effect of independent variables is constant over the distribution of the dependent variable used in the study. The OLS regression has some limitations such as the assumption regarding the marginal effect of the independent variable that is constant with the distribution.

However, the quantile regression (QR) is considered to be an extension of the linear regression analysis or the OLS that is used in this research. The quantile regression allows us to gain an understanding regarding the relationship between the variables outside the mean value of the data. Quantile regression eases the restriction for the predictor's coefficient imposed in OLS, the different coefficients are assessed to the corresponding quantiles. Using quantile regression enables this research to evaluate whether or not the disadvantage of testing scores for children from single-mother families depends on the distribution of testing scores itself. Besides, the effects of explanatory variables on the children's academic performance at particular percentiles are understood as well [66, 296, 292]. According to Koenker and Bassett [259], a QR model estimation can be illustrated as follows:

$$\begin{aligned}\bar{Y}_i =&\alpha_{\tau 2} + \beta_{\tau 21} Native_i + \beta_{\tau 22} MC_i + \beta_{\tau 23} SEA_i + \beta_{\tau 24} Oth_i + \gamma_{\tau 2} C_i + \sigma_{\tau 2} S_i + \nu_{\tau i} \\ =&X_i \theta_\tau + \nu_{\tau i}\end{aligned} \tag{4.3}$$

$$X_i \theta_\tau = (Quantile)_\tau (\bar{Y}_i | X_i), \tag{4.4}$$

where X_i is a vector of exogenous variables; θ_τ is the vector of coefficients; $(Quantile)_\tau(\bar{Y}_i|X_i)$ is the τth conditional quantile of $\bar{Y}_i$ given X_i, with $\tau \in (0, 1)$. The estimate of θ_τ is derived by solving the following argument:

$$\hat{\theta}_\tau \equiv \arg\min_\theta \sum_{i=1}^{n} \rho_\tau(z_i), \tag{4.5}$$

where $z_i = \bar{Y}_i - X_i\theta$ is the residual term, and $\rho_\tau(z)$ is a check function,

$$\rho_\tau(z) = \tau \times z \times I_{z \geq 0}(z) - (1 - \tau) \times z \times I_{z<0}(z). \tag{4.6}$$

The check function equals the value of $\tau \times z_i$ when the residual is positive and returns the value of $(\tau - 1) \times z_i$ when residual is negative. As τ is varied from 0 to 1, the entire distribution of the dependent variable. conditional on X, is traced.

According to Buchinsky [64], there are several benefits to use QR: (a) the models can

characterise the entire conditional distribution of a dependent variable given independent variables; (b) the estimates are not sensitive to the outlier observations; (c) when the distribution of error terms is not normal, the QR estimators may be more efficient than least squares estimators; (d) QR allows the discussion on the differential response of child's academic performance to the mother's nationality at different levels of that child's academic performance. Also, for though the optimization problem displayed in Equation (4.5) seems difficult to be solved, a linear programming representation can make it done easily.

4.4 Results

4.4.1 Composition of data

Table 4.3 lists the proportion of children from different family structures and the corresponding test results over the year. In our sample, the number of children from two-parent households predominates when compared to other family structures. The ratio for children in two-parent households is up to 82.74% while the percentage of children from single-mother households is 17.26%. In regard to the mother's country of birth, native single-mother accounted for the largest percentage of single mothers while the immigrant single-mother (i.e., Southeast Asia, Mainland China and other immigrants) add up to no more than 10%. This may be due to that immigrants might have different norms regarding marital dissolution, or might lack information about divorce regulation in the host country, divorce rates, hence, are bound to be lower among them [3].

Table 4.3: The Percentage of Each Family Structure

Family Structure	Whole Sample
Two-parent Family	82.74%
Single-mother Families	17.26%
Native	16.28%
Southeast Asia	0.46%
Mainland China	0.45%
Other Immigrant	0.07%
Observations	51,357

[1] Single-mother families include four family structures such as native, Southeast Asia, Mainland China and Other immigrant.

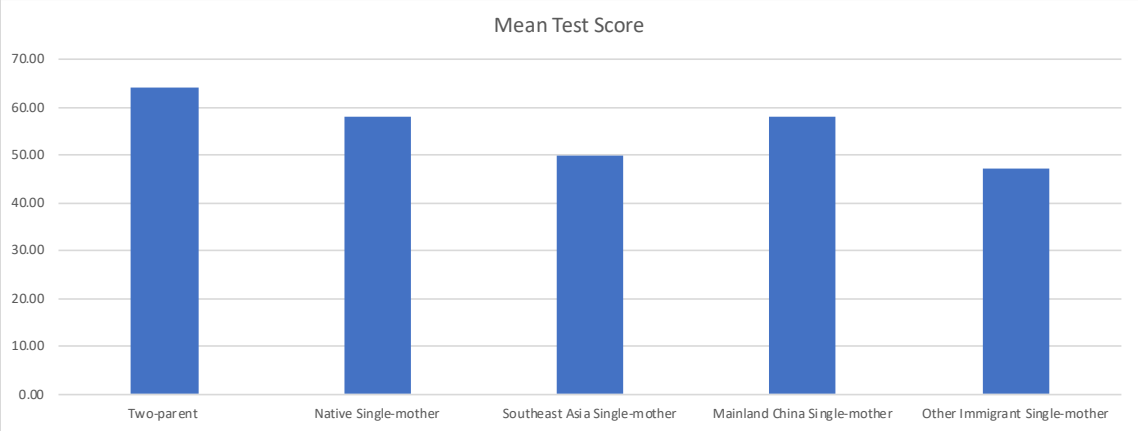


Figure 4.2: Mean test score of each family structure

In terms of test results, Figure 4.2 shows that the nationality of the mother plays a role. As expected, children from two-parent households have the highest academic performance compared to children from other family structures. Furthermore, children with native mothers appear to perform better than children with immigrant mothers in single-mother households, while the difference may be small for children with single mothers from Taiwan and Mainland China. This phenomenon could be due to the fact that both native and Mainland China mothers do not have the language barrier in Taiwan. They are therefore easier to communicate and to teach their children. Indeed, the language proficiency of immigrant mothers significantly affects children's learning [282].

4.4.2 Descriptive analysis

Table 4.4 shows the explanatory variables frequency distribution of whole sample and it is then categorised by family structures. The male represent 50.83% of the total observations and the female represent 49.17% of the total observations. Among the children, 90.96% of them have sibling presence while only 9.04% children are an only child at home. The percentage of sibling presence is low among the Chinese single-mother household. It may be due to that those mothers from Mainland China are the only child in the family because of the impact of China's one-child policy. Their thoughts on fertility are still continued to be affected by the policy and hence they are likely to have only one child at home [377]. Furthermore, single-mother households differ from two-parent households in the

Table 4.4: Summary statistics of variables by family structures

	Whole Sample	Family Structure				
		Two-parent	Single-mother			
Variables			Native	Southeast Asia	Mainland China	Other Immigrant
Gender						
Male	0.5083	0.5122	0.4896	0.5149	0.4957	0.3784
Female	0.4917	0.4878	0.5104	0.4851	0.5043	0.6216
Siblings						
Sibling presence	0.9096	0.9253	0.8384	0.8462	0.6754	0.8378
Only child	0.0904	0.0747	0.1616	0.1538	0.3246	0.1622
Mother's Education						
Illiterate	0.0065	0.0052	0.0095	0.1092	0.0518	0.1001
Elementary school	0.0473	0.0442	0.057	0.2077	0.1192	0.1667
Junior school	0.1531	0.1508	0.1591	0.2131	0.2953	0.2
Senior high school	0.484	0.4843	0.4922	0.3279	0.3109	0.2333
Junior college	0.1351	0.1377	0.1264	0.0219	0.057	0.1333
University	0.139	0.1419	0.1252	0.0929	0.1503	0.0333
Graduate school or above	0.035	0.0359	0.0306	0.0273	0.0155	0.1333
Home Computer						
Yes (1+)	0.9717	0.976	0.9514	0.9364	0.9652	0.8378
No	0.0283	0.024	0.0486	0.0636	0.0348	0.1622
Stored books						
Low (0-25)	0.3265	0.3034	0.4271	0.6949	0.5348	0.4595
Medium (26-100)	0.3321	0.3372	0.312	0.2076	0.2652	0.2432
High (100+)	0.3414	0.3594	0.2609	0.0975	0.2	0.2973
Main Language						
Chinese-speaking	0.8546	0.851	0.8738	0.7712	0.9214	0.7568
Non-Chinese speaking	0.1454	0.149	0.1262	0.2288	0.0786	0.2432

frequency distribution of variables used as indicators of family SES, such as whether or not they have at least one home computer and the number of books stored. The percentage of children with home computer is low among the single-mother families. Likewise, the number of books stored is on average lower than that of two-parent households. These results are consistent with existing literature indicating that the associations between single parenthood and poor material conditions and child poverty are found [135, 56].

For the education qualification of mother, around 0.65% of the children's mother are illiterate, the elementary school education is completed by 4.73% of the children's mother, junior school is completed by 15.31% of the children's mother, and Senior high school is completed by 48.40% of the children's mother. High literacy rates are common among the native single-mother families and two-parent households. Junior college is completed by 13.51% of the children's mother, university education is completed by 13.90% of the children's mother and the graduate school education is completed by 3.50% of the children's mother. Among the children, Chinese-speaking children represent 85.5% while non-Chinese speaking children represent only 14.5% of the whole observations. The Chinese language are spoken less among the other immigrant mother families.

4.4.3 Empirical results

This section has two parts. In the first part, we use regression analysis to evaluate whether the nationality of the mother influences the performance of children growing up in single-mother households. Furthermore, quantile regression analysis is used in the second part to assess whether the nationality of the mother has different effects on children with different achievement distributions.

Regression results

Table 4.5 shows that children with native single or immigrant single mothers (in terms of Mainland China single mother, Southeast Asia single mother and other immigrant single mother as a whole) receive significantly lower test scores compared to children with two parents, as children from two-parent households are the majority in this study, it is defined as a reference group. Compared to two-parent children, children of native single mother have 4.203 points lower than while children of immigrant single mother have 5.137 points lower. This finding is consistent with several studies showing that children from single-parent families perform less well at school than children from two-parent families [141,

354]. The disadvantaged impact of the country of birth of the mother on the academic performance of the children is higher for the children of immigrant single mothers. It is therefore clear that the nativity status of the mother has a significant impact on the test results of her children. The results of the study are consistent with those of Hernandez et al. [213], who found children of immigrant households suffered more academically.

We further split the immigrant mothers' nationality into Mainland China, Southeast Asia and other immigrants. Model B in Table 4.5 reveals that nationality of mother have significant influence on children's academic performance. Children of mothers from other countries (other immigrants) or Southeast Asia perform worse than children from Mainland China or native single mothers. This finding shows that for children whose mother is native or immigrated from China, the potential learning disadvantage can be dramatically reduced, because these mothers have no language barrier and take advantage of interacting with teachers to help children learn at school [282]. Moreover, children of Chinese single mothers do better than children of native single mothers.

In addition, male children and the presence of siblings are negatively associated with the children's test results. Mothers with higher levels of education tend to lead to higher test scores for their children. This may be because the mother is the main guardian who can help her children study academically in single-mother families, so if the mother's level of education is higher, she has enough knowledge to teach them. Children who live in the household using the destination language, Chinese, as the main language can perform better. Familial SES factors, such as whether or not there is at least one computer at home and the number of books, also strongly correlate with children's test scores. The score of children increases with the number of books stored and the presence of the computer. The study results are supported by the Coll and Marks [106], which argues that accessibility is the most important determinant of academic performance.

Table 4.5: Regression coefficients of different family structures

	(A)	(B)
Native	-4.203***	-4.202***
	(0.232)	(0.232)
Southeast Asia		-6.279***
		(1.334)
Mainland China		-2.660**
		(1.299)
Other Immigrant		-14.00***
		(3.253)
Single-mother Families	-5.137***	-14.00***
	(0.902)	(3.253)
Male	-1.651***	-1.653***
	(0.168)	(0.168)
Sibling presence	-1.221***	-1.203***
	(0.294)	(0.294)
Mother- illiterate	-16.26***	-16.21***
	(1.145)	(1.145)
Mother- elementary	-14.62***	-14.63***
	(0.610)	(0.610)
Mother- junior	-14.45***	-14.48***
	(0.513)	(0.513)
Mother- senior high	-10.69***	-10.72***
	(0.473)	(0.473)
Mother- junior college	-4.012***	-4.031***
	(0.505)	(0.505)
Mother- university	-2.683***	-2.711***
	(0.502)	(0.502)
Home-computer	5.307***	5.272***
	(0.516)	(0.516)
Stored books (Medium)	6.912***	6.907***
	(0.213)	(0.213)
Stored books (High)	10.90***	10.90***
	(0.223)	(0.223)
Chinese-speaking	5.374***	5.362***
	(0.250)	(0.250)
Constant	59.66***	59.72***
	(0.780)	(0.780)
Observations	45,034	45,034
Adjusted R-squared	0.185	0.185
F	730.4	639.9

[1] Estimates with stars are those statistically significant, where *, **, and *** respectively indicates the p-value to be smaller than 0.1, 0.05 and 0.01.

[2] Native represents native single-mother families. Single-mother families represent immigrant single-mother families including Southeast Asia, Mainland China, and other immigrant single-mother families.

Quantile regression results

Table 4.6 presents the marginal effect of the mothers' nationality (i.e., the coefficient of the mother nationality dummies) on the test scores of children placed at different score distribution based on Equations (4.3), (4.4), (4.5) and (4.6). The results of quantile regression analysis for selected quantiles (0.1, 0.25, 0.5, 0.75 and 0.9), as well as the OLS regression, which includes (along with all other regressors) the dummies for nationality of mother are shown. The coefficients of single mother's nationality are also summarised in Figure 4.3, which visualises the gaps in test scores along the selected quantiles.[6] From the OLS regression, children of other immigrant single mother have the lowest test score, up to 14 points lower than two-parent children. The test scores of children with native, Southeast Asia or Mainland China mother are also lower than that of children from two-parent households, but the gaps are less than half of the performance gap between children from other immigrant families and two-parent children. However, score gaps vanish for children with a mother from Mainland China in the middle and upper tail of the score distribution and for children with an other immigrant mother in the 25th percentile. Moreover, the significant test score gaps exist in the lowest quantiles for children with native, Southeast Asia, Mainland China or other immigrant mothers. The research findings indicates that, the children with lower score distribution are more easily to be affected by the disadvantages induced by mother's nationality.

The significant negative impact of Mainland China mother on children's test score only occur at the 10% and 25% quantile. However, children above average grades and with mothers from Mainland China even perform better than children of native mother. Moreover, the performance of children above average grades and with mothers from Mainland China do not have significantly test scores difference from children of two-parent households. Nevertheless, the under-performance of children with other immigrant mothers is much larger for children who has better academic performance (i.e., above 0.5 quantile). The under-performance of children at 90% percentile is 5.74 points more than the under-performance of children at 10%. This implies that those children who have immigrant mothers from other nationalities have lower grades on average when compared with those of mothers who are either native or come from Mainland China and Southeast Asia.

For the control variables, variables related to mother's education (illiterate, elementary,

[6]Specifically, the coefficients that are not statistically significant would be shown as 0 in Figure 4.3. For instance, the coefficients of single mother from Mainland China at 0.50, 0.75, and 0.90 quantiles.

Table 4.6: Quantile regression results

	OLS	Quantile				
		0.10	0.25	0.50	0.75	0.90
Native	-4.202***	-3.150***	-4.904***	-5.144***	-3.957***	-2.491***
	(0.232)	(0.418)	(0.366)	(0.323)	(0.296)	(0.269)
Southeast Asia	-6.279***	-5.982**	-6.733***	-7.279***	-8.445***	-3.802**
	(1.334)	(2.403)	(2.107)	(1.859)	(1.705)	(1.546)
Mainland China	-2.660**	-4.273*	-5.054**	-1.517	-1.229	-1.784
	(1.299)	(2.339)	(2.051)	(1.810)	(1.660)	(1.505)
Other Immigrant	-14.00***	-12.32**	-7.934	-17.16***	-17.58***	-18.06***
	(3.253)	(5.859)	(5.138)	(4.534)	(4.157)	(3.770)
Male	-1.653***	-3.810***	-3.511***	-1.450***	0.0782	0.657***
	(0.168)	(0.303)	(0.266)	(0.235)	(0.215)	(0.195)
Sibling presence	-1.203***	-1.016*	-1.369***	-0.967**	-1.779***	-1.021***
	(0.294)	(0.530)	(0.464)	(0.410)	(0.376)	(0.341)
Mother- illiterate	-16.21***	-16.09***	-18.83***	-17.66***	-15.86***	-14.49***
	(1.145)	(2.063)	(1.809)	(1.596)	(1.463)	(1.327)
Mother- elementary	-14.63***	-12.94***	-18.47***	-18.12***	-14.21***	-10.03***
	(0.610)	(1.098)	(0.963)	(0.850)	(0.779)	(0.707)
Mother- junior	-14.48***	-13.77***	-18.47***	-17.97***	-13.22***	-9.344***
	(0.513)	(0.924)	(0.811)	(0.715)	(0.656)	(0.595)
Mother- senior high	-10.72***	-11.17***	-14.80***	-13.20***	-8.658***	-6.238***
	(0.473)	(0.851)	(0.746)	(0.659)	(0.604)	(0.548)
Mother- junior college	-4.031***	-3.810***	-6.081***	-4.997***	-2.971***	-2.674***
	(0.505)	(0.910)	(0.798)	(0.704)	(0.646)	(0.586)
Mother- university	-2.711***	-3.715***	-4.431***	-3.415***	-1.765***	-1.415**
	(0.502)	(0.905)	(0.793)	(0.700)	(0.642)	(0.582)
Home-computer	5.272***	3.646***	4.530***	5.781***	6.829***	3.953***
	(0.516)	(0.929)	(0.814)	(0.719)	(0.659)	(0.597)
Stored books (Medium)	6.907***	5.317***	7.854***	8.672***	6.836***	4.453***
	(0.213)	(0.384)	(0.337)	(0.297)	(0.273)	(0.247)
Stored books (High)	10.90***	9.563***	12.87***	13.81***	10.44***	6.927***
	(0.223)	(0.401)	(0.352)	(0.311)	(0.285)	(0.258)
Chinese-speaking	5.362***	3.968***	5.707***	6.706***	5.493***	3.460***
	(0.250)	(0.449)	(0.394)	(0.348)	(0.319)	(0.289)
Constant	59.72***	39.49***	50.77***	59.77***	70.26***	82.24***
	(0.780)	(1.404)	(1.231)	(1.087)	(0.996)	(0.904)
Observations	45034	45034	45034	45034	45034	45034

[1] Estimates with stars are those statistically significant, where *, **, and *** respectively indicates the p-value to be smaller than 0.1, 0.05 and 0.01.
[2] Standard deviations are in parentheses.

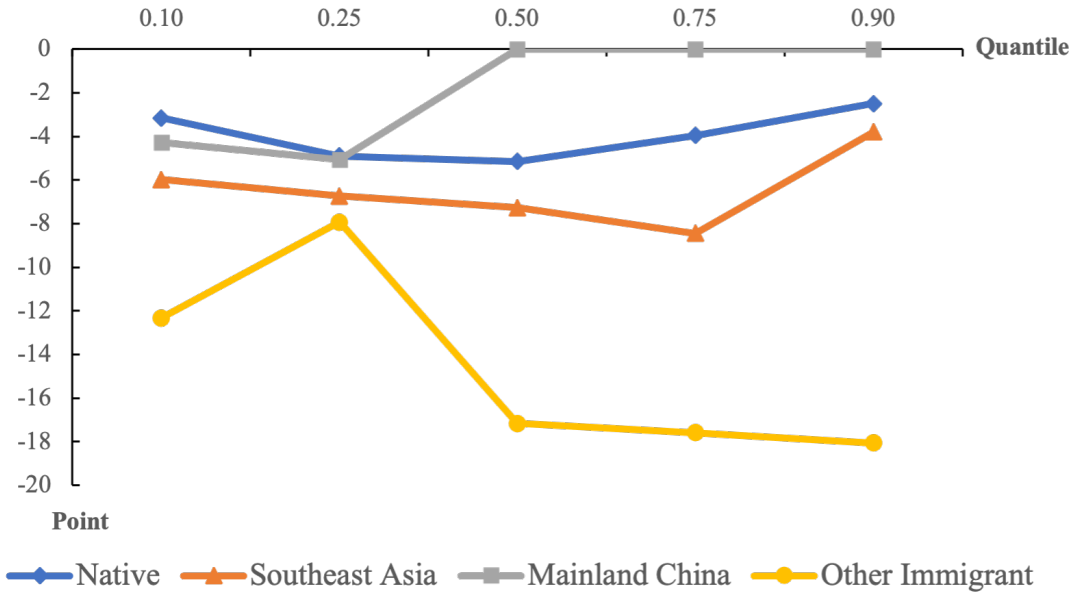


Figure 4.3: Gap in test score of children from single-mother family (by mother's nationality)

junior, senior high, college, and university) remains significantly negative at all quantile. Regardless of whether the children's grades are good or not, the higher their mother's education level, the higher their average score. Moreover, children at middle and lower quantile (say 0.1, 0.25 and 0.5) are more likely to affected by mother's education level than those of higher quantile (say 0.75 and 0.9).

4.5 Conclusion

International marriages have become a general demographic trend worldwide, especially in East Asian societies. International marriages have grown rapidly in Taiwan in the last decade, and have been accompanied by the rise in births of so-called 'New Taiwanese offspring'. The study of the educational outcomes of children from intermarriage is of particular importance, as it shows the long-term consequences of intermarriage [402]. There has been a lot of research on this topic. The literature focusing on the educational gaps of second-generation immigrant has largely centered around the children of two-parent households. Most of them compare the educational outcome of children with parents that were both born in Taiwan and children whose father was born in Taiwan with a spouse from Mainland China, Southeast Asia and from another origin [191]. Nearly all of these studies have excluded single-parent families from their analysis. However, since many foreign brides in Taiwan who married through commercial matchmaking broker instead of marring through their personal networks. The former are more likely to be relatively less educated and have lower socioeconomic status than the later. Therefore, immigrant brides who married through a broker were more likely to economically rely on their husbands, which may have led to a higher divorce rate [255]. Furthermore, as the divorce rate has been rising and especially the increasing divorce rate of transnational marriage is higher than non-transnational marriage [341], and the family led by divorced women as well as its children would suffer a disruptive impact on social and economic sides [30, 31, 168, 78]. These shocks also significantly contribute to a negative impact on the cultivation of children, e.g., emotion, cognitive ability, and behavior [215]. Therefore, it is crucial to investigate how vast the test score gap is observed between children from single-mother families and those from two-parent families, as well as how this gap changes when single mothers have different countries of origin.

The effect of mother's nationality on the academic performance of 8th grade children of single-mother households in Taiwan is addressed in this study. Moreover, we are allowed to

examine whether or not the mother's nationality affect children's performance differently among children with different test scores. We takes advantage of the Taiwan Assessment of Student Achievement data established by the National Academy for Educational Research Preparatory Office in Taiwan to empirically assess the influence of children with either native or immigrant mothers. We further compare the academic performance of children of five different family structures (two-parent, native single-mother, Southeast Asia single-mother, Mainland China single-mother and Other immigrant single-mother households) on cognitive knowledge (measured by test scores).

Our empirical results first show that the test score gaps do exist between children with immigrant single mothers and native single mothers after controlling for the children's individual characteristics and family background. We also show that, of children with immigrant mother, children of Mainland China mothers perform better than those with Southeast Asia and other immigrant mothers. This implies that immigrant mothers whose origin nation share the same language as the destination country will have fewer language barrier than other immigrant mothers. Therefore, they can have more effective communication with school teachers and in turn enhance the learning of their children [411, 363, 271, 362, 110, 245]. These imply that the government or policymaker should take into account the nationality of the mother when subsidizing immigrant children or enacting policies that are favorable to immigrant children.

Results from quantile regression reveal the children's gap in test scores is variant across both single mother's nationality and quantiles of selection. In particular, since the children of single mothers with the identity of 'other immigrants' generally have the worst test scores along the selected quantiles, the larger gaps in the top parts quantiles additionally suggest that these children should be given more attention to supporting measures than others to shorten the test score gap. Also, the children of single mothers with nationality in Southeast Asia have the second-largest gaps in the test score along most of the selected quantiles, of which the most substantial gap occurs on the 0.75 quantile (a mid-high level in test score distribution). For the children of single mothers from Mainland China, the most obvious gap in test scores is located at a mid-low position in the distribution of test scores (the 0.25 quantile), while the gaps are absent in higher quantiles. Lastly, the children of native single mothers at the 0.50 quantile (i.e., the middle part in the score distribution) have the largest gap in test scores. Based on these findings, effective remedies pertaining to improving the academic performance of second-generation immigrants should be tailored to both the country of origin for their single mothers and their current academic

performance if observed.

Chapter 5

The Impact of Cognitive and Non-cognitive Abilities on Immigrant's Labour Market Performance in UK: A Multilevel Modeling Approach

Abstract

Throughout this dissertation, the aims are to discuss the integration of immigrants throughout their lifetime. From childhood to adulthood, their main experience is the integration of the education system. When they grow up, they are confronted with the integration of the labour market. In Chapter 3 and Chapter 4, the integration of immigrants into the education system is evaluated using Taiwan's data set. However, due to Taiwan's lack of a complete database documenting the performance of immigrant adults in the labour market, it is difficult to comprehensively examine the performance of adults in the labour market, so we are looking for a database that differs from the previous two chapters for analysis. As a result, Understanding Society is chosen as a sufficiently large longitudinal survey of households to be used in this research. In particular, this data is up-to-date and accurate and provides comprehensive information on ethnicity and immigration in the UK, which is a desired advantage that most other datasets do not have. In addition, Understanding Society is the only comprehensive survey in the national household that covers detailed and year-on-year information on characteristics of people and their family background. This survey also includes a substantial number of minor groups as its sample.

The UK has seen a major increase in immigration over the last two decades, particularly for working-age populations. Existing evidence repeatedly shows significant immigrant labour market inequalities in Britain. In addition, earlier studies have discussed factors that could influence individual development of the labour market. From one perspective, cognitive ability is the most important determinant of labour market outcomes, while an alternative view is non-cognitive abilities are equal or more important than cognitive ability. Besides, evidence have shown that cognitive is important for the immigrant integration into labour market. Yet, little progress has been made in understanding the various association between non-cognitive ability and immigrant integration among different immigrant groups. Building on the Understanding Society, the UK Household Longitudinal Study and a multilevel modeling, this study aims to determine how differences in cognitive and non-cognitive ability contribute to differences in the pace of migrant integration into the labour market in terms of earnings capacity. Key findings show that overall, cognitive abilities, on average, have significantly positive impact on the income of individuals, while non-cognitive abilities have a non-statistically significant impact of overall observations. If we look at the effects between the different groups that are focused in this study, however, the return of non-cognitive ability vary among different groups. Non-cognitive ability play a role in explaining income inequality and income growth gaps between different groups. In addition, cognitive skills can only explain the difference in income growth between different groups.

The findings and results of the Understanding Society analysis can be used as a reference for countries without a comprehensive set of data documenting the labour market performance of immigrants. The results can give policymakers possible problems in the future labour market for immigrants in advance, which underscores the importance of research in Chapter 5.

5.1 Introduction

Since the 1990s, net migration has been the main driver of population growth in the UK [155]. Indeed, by 2020, it is estimated that 9.5 million people in the UK are not born in the UK, which indicates a roughly 14% of non-UK-born population in the UK [156]. Yet despite the UK's popularity as a destination for migrant groups, variable public and political attitudes towards immigration contributes to uneven experiences on arrival and settlement. In particular, a robust evidence base demonstrates the labour market disadvantage experienced by migrant groups relative to the native population. This disadvantage is both socially unjust and economically problematic, particularly where migration policies exist to welcome migrant groups into society and the labour force.

Experiences of integration vary between migrant groups, depending on their socioeconomic and demographic background. Research has demonstrated that ethnic minority groups, including international migrant groups, are routinely disadvantaged in the labour market. Their labour market outcomes are hindered by the limited knowledge of the functioning of the labour market of the destination country [260], shortages in language skills [412] and country-specific cultural norms [112, 366].

Discrimination, whether based on the colour of ones skin or ones religions background, may be experienced within the recruitment process, and when in employment (e.g., in terms of the job obtained, income earned, security of contract, or opportunities for progression). Persistent disadvantages based on ethnic and racial discrimination practices can question so-called meritocratic society, hinder social mobility, and reinforce social reproduction in existing structures of inequality [184]. Immigrants remain permanently in secondary labour markets, with few opportunities for upwards social mobility and with low-paying jobs [172]. In the UK, Clark and Lindley [101] find non-white immigrants to have significantly reduced earnings relative to the native population. Further, where non-white migrants are discriminated against in the recruitment process, this contributes to lower rates of employment [101]. Cultural and religious considerations are also implicated where low rates of employment and economic activity are observed amongst Muslim migrant groups [102].

Hahn et al. [192] highlight a number of key cognitive ability relevant to experiences of integration for different migrant groups, including factors such as educational history and language ability. Cognitive abilities, also known as cognitive skills or cognitive capacities, are brain-based skills required to acquire knowledge, manipulate information, and

think. Cognitive skills include attention, perception, learning, memory, language skills and decision making [252]. Yet there exists a significant gap in literature as to the role of non-cognitive ability in the context of integration. Non-cognitive ability that can be broadly defined as personality traits or thought, feelings and judgment patterns [51]. For instance, the Big Five personality traits, including Openness to Experience, Conscientiousness, Extroversion, Agreeableness, and Neuroticism. Recent research established that non-cognitive ability are crucial determinants of economic outcomes such as employment and earnings [69, 290, 285, 175]. In line with Segal [376], non-cognitive abilities enhance the ability of individuals to gather human capital, and affect their choice of occupation and specialization [26].

Despite growing evidence as to the importance of non-cognitive ability in shaping labour market outcomes, such as employment and earnings, we are yet to see literature examining the significance of non-cognitive ability for migrant integration into the labour market. With regard to ethnic diversity in the UK and the immigrant status of individuals, 12 groups of people are included in our study, including native British whites, native other whites, native Asians, native blacks, native mixed, native Others, immigrant British whites, immigrant other whites, immigrant Asia, immigrant blacks, immigrant mixed and immigrant others.[1] The objectives of this paper are as follows:

1. To examine the differences in the pace of integration amongst migrant ethnic groups.

2. To determine the ways in which variances in cognitive and non-cognitive ability contribute to differences in the pace of migrant integration into the labour market.

The remainder of this study is organised as follows. The brief history of immigrants in the UK is presented in Section 5.2. Section 5.2 also presents the literature on the integration of immigrants and underlines the discussion on the effects of cognitive ability on the integration of immigrants. Section 5.3 introduces the data set and specifies two key ability that are focused in this study, while the estimation strategy is presented in Section 5.4. Descriptive results and empirical results are presented and discussed in section 5.5. The final section provides the conclusion and implications of this study.

[1]The immigrant status of an individual indicates whether or not he/she is born in the UK, while ethnicity is the fact or state of belonging to a social group with a common national or cultural tradition.

5.2 Literature review

5.2.1 Immigrant history of the UK

Britain is well known as a country of immigration, where the history of immigration can be connected to many historical events, e.g., the invasion of Romans in 1st century BC and the migrations of Anglo-Saxons started from 5th century. Nowadays, the inflow of population from other countries appears not to cease in Britain. Even in the 20th century, there are still notable inflows of population to Britain, and these can also correspond to the evolution of European history.

Refugees from other places in Europe had already played out at the beginning of the 20th century. Many minorities (such as Jews) emigrated from Germany and Austria in the lead to World War II, when they were under Nazi rule or influence. After the war, the British Nationality Act 1948 allowed the people in the British Empire to live and work without a visa [196], which generated massive emigration from the former territory of the empire, but later lead to restrictions on the qualification of immigrants.

There have been many debates and works on immigration legislation. Eventually, the Commonwealth Immigration Act 1968 was passed, which first required migrants to have a connection with a British citizen by birth or ancestry. The Immigration Act of 1971, which further regulated people with work permits or people with parents or grandparents born in the UK, effectively stemmed main immigration from Commonwealth countries [58]. In addition to immigration from Commonwealth countries, the United Kingdom also experienced a lot of immigration from other areas after World War II, such as people from the former Soviet Union who settled in the United Kingdom, especially Poles and Ukrainians. These displaced people coincidentally filled labour demand for industries for the UK's economic recovery [248].

There is still another stream of migrants from other European countries due to UK participation in the European Union (EU) before 2020. Citizens of the EU can obtain work permits within the EU. Thus, the expansion of the EU naturally leads to immigration inflows into the UK. The expansion of the EU in 2004 results in an additional workforce of 5 million new members of the EU between 2004 and 2009 [394, 128]. Immigrants from Asia also contribute to a significant accumulation of non-UK-born population in the UK. According to ONS [156], there are 9.5 million non-UK-born populations in the UK in 2020, of which Indians, Poles, and Pakistan are the most common. The above factors (including

policies and historical events) jointly make the UK a country with a large number of immigrants and a society of a diverse ethnicity.

Much recently, with the UK's exit from the EU, it documented some measures to reform the immigration system, such as ending the previous freedom of movement of migrants from the EU and advancing a new point-based system, both of which have entered into force since 1 January 2021. These reform policies would treat EU and non-EU applicants for migration to the UK equally, and the new system would require applicants to earn certain points to qualify for the right to work and live in the UK. The salary and qualification threshold would be lower, so a large pool of qualified workers from all over the world could come to the UK. The administrative process would be simpler and quicker, so that employers can recruit foreign workers at a lower cost (either in terms of the time consumed or in terms of the money consumed). Although it will likely appeal to more skilled workers to meet market demand in the UK, the impact of reforming the immigration system is yet to be evaluated. Indeed, a comparable version of the points system in Australia has generated a high level of migration [393]. According to the UK government's declaration, these reforms aim to end freedom of movement and create a fair and firm system for immigration applicants from anywhere in the world. By applying these amendments, the distorted immigration system (by European freedom of movement) can be transformed in order to bring benefits to the UK and meet the demands of the British people.

5.2.2 Integration of immigration

The term integration is commonly used in the context of the participation of immigrants in, and how they incorporate into the host communities and societies [189]. The concept was founded on functional and structural assumptions that immigrants constitute an alien aspect that needs to be adjusted and connected to society or a community with well-outlined boundaries, and integrated cultural and social systems [189].

Due to its multi-faceted nature, immigration plays a crucial role in the functioning of labour markets in modern economies. For instance, economic researchers have pointed out that immigrants help realise economic growth and decrease inflationary pressures, either by filling the existing skill inadequacies, or reducing wage demands [46]. The integration of immigrants boosts the labour force and carries a positive impact on the levels of income and public finances in recipient nations over the long term, more so in nations with aging populations such as the UK [189].

A number of studies have established that international migration has a limited impact on the average salaries and employment opportunities of native employees [265, 337, 345, 187]. In line with the World Bank Group [187], the effect of immigration on fiscal accounts is largely based on the immigrant's income and their integration into the labour market, and how the social security system functions in host economies. Amongst migrants, the employment and earning gaps are common in the initial years. However, they fall as migrants attain language proficiency and get more relevant experience pertaining to their jobs or areas of expertise [265]. Research has suggested that migrants value their integration into the labour market primarily for economic reasons [99], seeking to send remittances to their home countries, or to save money for housing or business investments in their native nations [99].

Experiences of integration vary amongst the highly diverse migrant population within the UK [145]. For example, pace of integration varies depending on educational attainment, vocational skill-set, and language proficiency [145]. This may lead to disparities between migrant groups from different countries given variations in the socioeconomic contexts at origin. It may, for example, be anticipated that migrants from Western and European countries with similar education systems and labour market structures to the UK will experience a faster pace of integration than migrants from elsewhere. One pathway by which to examine differences in the pace and nature of integration is through earnings and wage gaps.

Immigrants from different areas might have different experience and performance in labour market. According to [158], immigrants from the EU are more likely to be hired than those from non-EU. Also, immigrants from different areas of the EU might also have distinctive labour market performance. For example, Polish migrants typically have lower returns to their education than others [130]. The distribution of occupations sorted by skill level is unequal for migrants from various countries/areas. Most Polish (as well as other A8 countries) migrants are employed in the occupation with low skill, while most EU14 (including Irish) and EEA migrants are serving in the occupations with high skill [243].[2] Compared with natives in the UK, Polish are more likely to work in the bottom ladder of occupation distribution and wage distribution [243]. The gap in the labour market

[2] A8 includes countries admitted to EU in 2004, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. EU14 contains Austria, Belgium, Denmark, Finland, France, Germany, Greece, Republic of Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and Sweden. EEA indicates the member of the EU, as well as Liechtenstein, Iceland, and Norway.

performance between non-European immigrants and natives in the UK is also a noticeable issue. Based on the figures disseminated by ONS, immigration from Asia plays a role of the second majority in the labour market of the UK (in terms of the number of employment).[3] For though immigrants from India are usually more educated than the UK natives, the Indians with longer working experience usually earn less or not more than the natives [38]. In addition, ethnicity plays an important role in determining labour market outcomes in the UK. Blackaby et al. [45] find significant differences between different ethnic groups - Pakistanis and Bangladeshis have particularly low employment chances.

Cognitive ability and immigrant integration

Research carried out by Hahn et al. [192] established that cognitive ability such as language ability and initial education are of importance to the integration of migrant groups into a labour market (see also [202, 350]). Indeed, the European Commission [107] also highlights that proficiency in language ability is crucial for integration.As pointed out by Robert et al. [361], human intelligence is a powerful indicator of employment success, and is seen to specifically portray itself in novel circumstances that need adaptation or change. Integration into a new economic or social system may be seen as a circumstance that requires the efficient use of an individual's cognitive ability [192].

Cognitive ability development plays a critical role in information processing, making decisions, and learning, which likely contribute to experiences of integration into the labour market after integration. However, non-cognitive ability such as motivation and personality traits likely also contribute to experiences of integration [51, 192]. Previous research has established that social interaction, which has a close correlation to the extroversion personality trait, has a positive correlation with employee behavior and performance [209].

Personality, as a non-cognitive skill, is crucial for adjusting intra- and inter-personal ability. Social dynamics such as relationships and interactions, have an intimate correlation with personality variances, and they result in a less or more positive self and satisfied personality [23]. Thus, personality elements, specifically personal variances in communion and agency, have been proven to have a close association with social outcomes like the quantity and quality of friendship [24], together with intrapsychic adjustment, such as subjective health, self-esteem, and wellbeing [114]. In addition, integration into the labour

[3]Source of figures is the dataset 'EMP06' released by ONS, which mainly reports the employment by country of birth and nationality.

market has been associated with proactive elements such as sensation seeking, activity level, and sociability [374].

Clearly, the role of cognitive ability in influencing the pace of integration of migrants in Britain has been largely evaluated. However, there are limited studies that address the potential of non-cognitive ability in the process of labour integration. Based on the concept of Heckman et al. [210] in terms of the formation of human capital, it is evident that non-cognitive ability are as important in the formation and development of the labour market as cognitive ability.[4] A study by Nejad and Schurer [325] also points to the role of non-cognitive ability in the workplace, arguing that a person's non-cognitive ability are crucial in strengthening their cognitive ability, both in education and in the labour market. Accordingly, Mỳtna Kureková et al. [319] also point out that in order to solve the inequalities in employment between immigrant groups, it is imperative that both cognitive and non-cognitive ability be recognised in the labour market. To this end, the aim of this study is to fill those gaps. We aim to analyse the differences in non-cognitive ability and to assess their role in the existing variation in the integration of immigrants into the labour market.

5.3 Data and measures

5.3.1 Data source

The UK Household Longitudinal Study (UKHLS), also known as Understanding Society, builds upon the earlier British Household Panel Study. Understanding Society is excellent in conducting ethnic research, as it covers a wide range of ethnic groups that are usually insufficient in other longitude studies [65]. UKHLS is a comprehensive survey that has been launched since 2009 and consists of 40,000 households in the UK. It incorporated from the outset distinctive features that make it a valuable data for research in many areas, such as analyses of ethnicity and migration, biosocial studies and research on the relationship between factors in society, environment and institution, and personal attributes. Moreover, Understanding Society has integrated development and innovation into methodology in its long history, which makes data more comprehensive and inclusive in terms of its collection form.[5] Most respondents, not all, are contacted annually in the UKHLS to gather in-depth

[4]From human capital theory, Heckman et al. [210] establish that cognitive and non-cognitive skills justify specific labour and behavioral outcomes.

[5]For further details related to UKHLS have been previously reported Lynn [291] and Platt et al. [347].

information about the life of respondents in terms of social and economic circumstances, attitudes and behaviors, which provides long-term and fruitful survey results for people and their families.

However, the UKHLS could have some limitations. Firstly, although the UKHLS includes a sample design (The Immigration Ethnic and Minority Boost) to increase the representation of immigrants and ethnic minorities, the interviews are conducted in areas identified as intensive with ethnic minorities, which could be associated with selection bias. However, simple random sampling in these areas reduces selection bias in the perspective of micro-levels [333]. Second, the problem of non-response is another potential concern when using UKHLS, as mentioned in some studies (e.g., [250, 424, 423]). Despite some concerns, this data is used to produce many empirical research on labour markets, immigrant and ethnic minorities in the UK. Among these studies, some have adopted the sampling weight to potentially adjust the representation of certain ethnic or immigration groups or sample attrition [379, 424, 423, 228], while others have not (e.g., [333, 127, 263, 250]). This discrepancy could be due to the existence of struggles in using survey weight, as mentioned in Gelman [174], e.g., the construction of the sample weight itself is not a codified process. The way to adjust the bias in the sample mean by using weights is also intuitional, but it may not work as well for further complicated statistics. The use of survey weight in research can lead to biased conclusions on interest parameters, and therefore a thoughtful and sensible method of coding survey weight is required for empirical methods that are complicated, e.g. multi-level modelling used in our research [79]. Therefore, our empirical analysis does not use sample weight due to a lack of knowledge of the production of appropriate adjusted weight.

Due to the fact that UKHLS has contained fruitful contents, we employ it to investigate the relationship between cognitive and non-cognitive ability and migrant integration into the labour market. The extent and pace of migrant integration are assessed according to income and income growth, with comparisons between different migrant ethnic groups relative to the native British white population. The data used in this analysis are taken from the General Population Sample and use the individual files from Wave 3 (2011 to 2013) to Wave 8 (2016 to 2018). Wave 3 captured information on both cognitive and non-cognitive abilities. The observations are either identified as native or immigrant and classified according to ethnicity. 12 groups of people are included in our study, including native British whites (NBW), native other whites (NOW), native Asians (NA), native blacks (NB), native mixed (NM), native Others (NO), immigrant British whites (IBW), immigrant other

whites (IOW), immigrant Asia (IA), immigrant blacks (IB), immigrant mixed (IM) and immigrant others (IO). Valid observations across waves and ethnicity groups are shown in Table 5.1, and Table 5.2 summarises the variables in our analysis.[6] There are 95,148 valid observations from wave 3 to wave 8. The size of valid observations decreases as the survey wave rolls due to the filtering of the data and the inevitable occurrence of sample losses in adjacent waves. Of valid observations, the native British white is the majority (78.5%) among the native sample, with minor part in natives composed with Asian (3.0%), other white (2.6%), black (1.4%), mixed (1.2%) and other (0.2%). The Asian is the major group in immigrant sample, which accounts 5.5% of whole valid sample, while the other international migrant population split between other white (2.7%), black (2.0%), British white (1.8%), mixed (0.5%) and other (0.5%) migrant groups.

Table 5.1: Sample size by Wave and Ethnic Groups

	Wave							
Ethnic Groups	3	4	5	6	7	8	Row Sum	Proportion of Row Sum
Native British White	15,671	13,988	12,769	11,427	10,675	10,195	74,725	78.5%
Native Other White	533	477	429	373	347	330	2,489	2.6%
Native Mixed	241	209	198	170	140	142	1,100	1.2%
Native Asian	675	567	484	407	361	341	2,835	3.0%
Native Black	300	252	222	194	182	166	1,316	1.4%
Native Other	44	39	39	37	28	25	212	0.2%
Immigrant British White	354	312	295	275	256	252	1,744	1.8%
Immigrant Other White	573	493	437	391	356	341	2,591	2.7%
Immigrant Mixed	104	89	77	71	64	60	465	0.5%
Immigrant Asian	1,188	1,023	890	796	707	666	5,270	5.5%
Immigrant Black	485	386	315	260	225	214	1,885	2.0%
Immigrant Other	124	101	93	74	64	60	516	0.5%
Column Sum	20,292	17,936	16,248	14,475	13,405	12,792	95,148	
Proportion of Column Sum	21.3%	18.9%	17.1%	15.2%	14.1%	13.4%		

5.3.2 Two key abilities

Cognitive ability

Five aspects of cognitive ability are captured in the UKHLS at wave three, covering different aspects of mental skills and abilities. The indicators, which have been used extensively across a range of surveys and research, include verbal memory [332, 233], semantic verbal

[6]The valid observations indicate the observation left after filtering the entire sample according to the variable contained in this analysis.

Table 5.2: Description of variables

Variables	Description of Variables	Attribute
Dependent Variables		
Income	Include net usual pay (from current job), net self-employment income, and net pay in the second job. Average monthly labour income logarithm	Time-variant
Income growth	The difference between the logarithm of the average monthly income between time t and t-1	Time-variant
Independent Variables		
Ability		
Cognitive Ability (CA)	Cognitive ability includes 5 aspects: word recall, substraction, number series. Verbal fluency and numeric ability We normalised each of them and then take average	Time-invariant
Non-cognitive Ability (NC)	Non-cognitive ability includes 5 aspects: agreeableness, conscientiousness, extraversion, neuroticism, openness We normalised each if then and then take average	Time-invariant
Ethnic groups		
Groups	Categorical variables: 1 is native British white (NBW), 2 is native other white (NOW), 3 is native Asian (NA) 4 is native black (NB), 5 is native mixed (NM), 6 is native others (NO) 7 is immigrant British white (IBW), 8 is immigrant other white (IOW), 9 is immigrant Asia (IA) 10 is immigrant black (IB), 11 is immigrant mixed (IM), 12 is immigrant other (IO)	Time-invariant
Other variables		
Age	Individual's age	Time-variant
Rural Area	Dummy variables: Area=0 is for rural area; Area=1 is for urban area	Time-variant
Country of Residence	Categorical variables: 1 is for England, 2 is for Walse, 3 is for Scotland, 4 is for North Ireland	Time-variant
Gender	Dummy variables: gender=0 is female; gender=1 is male	Time-invariant
Education qualification	Categorical variables: 1 is individual without qualification, 2 is individual with other qualification, 3 is individual with A level or GCSE, 4 is individual with degree or other higher degree	Time-variant
Language ability	Categorical variables: 1 is very poor, 2 is poor, 3 is fair, 4 is good, 5 is excellent	Time-invariant
Year since migration	Categorical variables: 0 is UK born, 1 is individual whose survey year minus year to Britain less or equal to 4 years; 2 is individual whose survey year minus year to Britain more than 5 year and less or equal than 9 years; 3 is individual whose survey year minus year to Britain more than 9 years	Time-variant
Mother's education	Categorical variables: 1 implies mothers do not go to school at all; 2 implies she left school with no qualification or certificates; 3 implies she left school with some qualifications; 4 implies she gained post school quals or certs; 5 implies she gained a uni degree or higher degree	Time-invariant
Father's education	Categorical variables: 1 implies fathers do not to school at all; 2 implies he left school with no qualification or certificates; 3 implies he left school with some qualifications; 4 implies he gained post school quals or certs; 5 implies he gained a uni degree or higher degree	Time-invariant
Paid employment	Categorical variables: : 0 is those unemployed, 1 is those self-employed, 2 to 12 are those in paid employment with different types of job	Time-variant
Job change	Dummy variables: 0 for having the same job as previous wave; 1 for changing the job in this wave	Time-variant
Number of conversion jobs	The total number of conversions until this period	Time-variant

fluency [269, 267, 286, 359], fluid reasoning [147], subtraction [332, 232], and numerical reasoning [332].

Non-cognitive ability

Non-cognitive ability are defined according to five personality traits commonly referred to as 'the big five': Agreeableness (A), Conscientiousness (C), Extroversion (E), Neuroticism (N), and Openness (O). These personality traits were measured in Wave three (in 2011) using a version of the Big Five Inventory (BFI) containing 15 items [239]. This made use of three items per personality trait. These three items were then used to calculate a item score for each trait. The measure used was a 7-point Likert scale which consists of choosing a number between 1 and 7 where 1 means 'does not apply to me at all' and 7 means 'applies to me perfectly'.

Measure of cognitive and non-cognitive ability

To allow for comparison, the ten variables identified above capturing cognitive and non-cognitive ability are first standardised as follows:

$$Y = \frac{X - X_{min}}{X_{Range}} \times 100, \tag{5.1}$$

where Y is the adjusted variable, X is the original variable, X_{min} is the minimum observed value on the original variable, X_{Range} is the difference between the maximum score and minimum score on the original variable and 100 is the upper limit of the re-scaled variable. A summary score is then created by summing the respective five adjusted variables for either cognitive or non-cognitive ability, and calculating the average score.

5.4 Model specification

Two multilevel models are specified for the analysis, the income model and the income growth model. The two models share the same explanatory variables and settings of fixed and random effects, differing only in the outcome: income, or income growth. The detailed model specifications are as follows.[7]

[7]The fixed and random effect here is different from those inferred from panel data modelling.

5.4.1 Income model

The income model assesses the various effects of cognitive and non-cognitive ability on an individual's average monthly income for different groups and for different waves. The model utilised in this study contains two levels, where the first is the individual level and the second is the level of ethnic groups as well as wave. In the analysis of the multilevel model, individual or observation is usually set at the first level, while the grouping or nesting variable of interest would be set at the higher level. Level 1 estimates individual average income as a linear function of the cognitive and non-cognitive abilities with a variety of control variables included. Table 5.2 shows the details of variables :

$$Income_{iwg} = \beta_{0w} + \beta_{1wg}CA_{iwg} + \beta_{2wg}NC_{iwg} + X'_{iw}\gamma + X'_{i}\mu + \varepsilon_{iwg}, \tag{5.2}$$

$Income_{iwg}$ represents the logarithm-transformed average monthly income for individual i of ethnic group g in wave w. To produce $Income_{iwg}$, the nominal income of each observation is first adjusted by the Consumer Price Index (CPI) to give the $RealIncome_{iwg}$. To align the nominal income for each wave, spanning a three year period, the CPI value used is obtained by averaging the CPI in the corresponding three years.

$$RealIncome_{iwg} = \frac{Nominal\_Income_{iwg} \times 100}{\frac{1}{3} \times \sum_{t=w+2008}^{w+2010} CPI_t}, \tag{5.3}$$

where t is year. Second, we rescale the values of $RealIncome_{iwg}$ and then take a log transformation as follows.[8]

$$Income_{iwg} = ln(RealIncome_{iwg} + 17,979). \tag{5.4}$$

In Equation (5.2), CA_{iwg} and NC_{iwg} are respectively the cognitive ability and non-cognitive ability of individual i. X_{iw} is a vector of variables that captures the characteristics of the individual, which vary over time, including age, rural area, country of residence, education qualification of own, year since migration, employment statement, job change, and number of conversion jobs. X_i is a vector of variables that captures the time-invariant char-

[8]To ensure all $RealIncome_{iwg}$ are positive values, the observed minimum value (17,979) is added to all negative values. Negative nominal income may be due to the fact that the individual is self-employed.

acteristics of the individual, including gender, language ability, and educational attainment of parents. Most predictors are included as dummy variables in the model, except for age, which is a continuous variable. Remarkably, in terms of the fact that wage and age may have a U-shaped relationship, age-square is also considered in the model, just as the square term of working experience is considered in the Mincer earnings equation [305, 306]. ε_{iwg} is the Level-1 error term.

At level 2, the intercept and slope of both the cognitive and non-cognitive abilities in Equation (5.2) become the outcome variables. This specification allows β_{0wg}, β_{1wg}, and β_{2wg} to be randomly varying by time (wave) and by group:

$$\beta_{0wg} = \theta_{00} + \mu_{0w} + \nu_{0g} \tag{5.5}$$

$$\beta_{1wg} = \theta_{10} + \mu_{1w} + \nu_{1g} \tag{5.6}$$

$$\beta_{2wg} = \theta_{20} + \mu_{2w} + \nu_{2g}. \tag{5.7}$$

θ_{00} represents the average income (or the baseline) of all observations across waves and groups. μ_{0w} and ν_{0g} are both the random effect of the intercept, which respectively capture the potential deviation for time w and for group g from the average income of all observations. θ_{10} is the estimated average value for CA_{iwg}'s slope, which represents the fixed effect of cognitive ability on income, while μ_{1w} and ν_{1g} respectively capture the random variation on CA_{iwg}'s slope across time and that across group. θ_{20} is the estimated average value for NC_{iwg}'s slope, which plays the role of the fixed effect of non-cognitive ability on income, while μ_{2w} and ν_{2g} work as random effects, which can be respectively interpreted as the variation on NC_{iwg}'s slope across time and group.

In addition to the above specification, a multi-level model is shown in particular by assuming that the Level-2 error terms are normally distributed and correlated, that is, $cov(\mu_{jw}, \mu_{kw}) \neq 0$ and $cov(\nu_{jg}, \nu_{kg}) \neq 0$ for $j \neq k$. It is a reasonable assumption or condition for the data with nest or multiple-level structure (in this research the wave or ethnic group). It is also assumed that the cross-level correlation between random variations is zero.

5.4.2 Income growth model

The income growth model assesses the effects of cognitive and non-cognitive ability on an individual's income growth across different groups. The model contains two levels, where the first the individual level and the second is the level of groups. Level 1 estimates individual's average income as a linear function of the cognitive and non-cognitive abilities with additional control variables included, such as personal attributes and family background information (see Table 5.2):

$$Income\_Growth_{iwg} = \beta_{0wg} + \beta_{1wg}CA_{iwg} + \gamma_{2wg}NC_{iwg} + X'_{iw}\gamma + X'_i\mu + \varepsilon_{iwg}, \quad (5.8)$$

In Equation (5.8), $Income\_Growth_{iwg}$ represents the growth in logarithm of the average monthly income (from time $w-1$ to w) for individual i of group g in wave w. To aid interpretation, time is coded as 'wave'. CA_{iwg} and NC_{iwg} are, respectively, the cognitive ability and non-cognitive ability of individual i. X_{iw} is a vector of variables that capture the characteristics of the individual, which vary over time. X_i is a vector of variables that capture the time-invariant characteristics of the individual.

At level 2, the intercept and slope of both cognitive and non-cognitive abilities in Equation (5.8) become the outcome variables. This specification enables us to allow β_{0wg}, β_{1wg}, and β_{2wg} to exhibit random volatility over wave and over group:

$$\beta_{0wg} = \theta_{00} + \mu_{0w} + \nu_{0g} \quad (5.9)$$

$$\beta_{1wg} = \theta_{10} + \mu_{1w} + \nu_{1g} \quad (5.10)$$

$$\beta_{2wg} = \theta_{20} + \mu_{2w} + \nu_{2g}. \quad (5.11)$$

Parameters and random variation terms in the above three equations share the same assumption as those in the previous Income Model. θ_{00} represents the average income growth of all observations, while θ_{10} and θ_{20} are the fixed effect (or the influence on average) that cognitive ability and non-cognitive ability have on income growth. μ_{0w}, μ_{1w}, and μ_{2w} represent the random effect of the intercept, cognitive ability's slope, and non-cognitive ability's slope respectively, which capture the random variation across wave. ν_{0g}, ν_{1g}, and ν_{2g} are the random effect of the intercept, cognitive ability's slope, and non-cognitive ability's slope respectively, which capture the between-group random variation on the parameters.

5.4.3 Advantages of using multilevel model

Accounting for random intercepts and random slopes in a multilevel model is associated with many advantages [308, 270]. First, the random intercept can be used to analyse the variance between the waves (as well as the variance between the groups), which is due to different levels of labour income and labour income growth. Secondly, the effects of cognitive and non-cognitive skills on earning and earning growth can also vary depending on waves and groups, so a setting of random slopes containing variance components is used. Furthermore, the assumption of non-independence between the random variation in Level-2 would lead to the OLS estimator of the parameters being less efficient, depriving the reliability of the test hypothesis of the parameters. Therefore, it is of great concern to use alternative approaches to obtain parameters in the framework of a multilevel model.

In this research, parameters of multilevel model are estimated by using REML (Restricted Maximum Likelihood) rather than using MLE (Maximum Likelihood Estimator) or OLS (Ordinary Least Square).[9] Further details of the implementation can be found in the official and instructive document for these packages. Because the variance estimate of MLE is usually downward biased and the dependent random errors violate the assumption of white noise of using OLS, while REML can provide estimates with concerns in the context of a multilevel model [198].

5.5 Results

5.5.1 Descriptive statistics

In both native and immigrant observations, there are 6 ethnic groups (British white, other white, mixed, Asian, black, other) respectively, and Table 5.3 and Table 5.4 respectively show the summary statistics for the variables used in this study of native groups and immigrant groups. From Table 5.3, average of logarithm of real income is 9.8634 for whole sample, and the difference of average of logarithm of real income across ethnic groups appears moderate. Among native groups, British whites, mixed and blacks are the three highest earners, while others and Asians are the lowest. According to Table 5.4, immigrant British whites, immigrant other whites and immigrant mixed are the three groups with

[9]Empirical results are obtained by using lmer-package and merTools-package within R-language, where the former is used to estimate the coefficients of multilevel model and the latter is used to test the significance of random effect (by a simulation approach).

the highest income. Moreover, the income gap for each ethnic group between immigrants and natives is not significant.

Average real income growth is 0.0004, which means that most ethnic groups are growing over time, with only one exception in immigrant British whites with negative growth in real income. Among native groups, most ethnic groups share higher income growth than British whites, while only other whites have slightly smaller growth than British whites. For immigrant groups, each ethnic group has a higher income than British whites.

The average cognitive ability for the entire sample is 62.0. Among all groups, British white groups tend to perform better in cognitive ability than other groups, and the immigrant British whites and native British whites have the highest and second highest cognitive ability (64.3 and 63.2). In addition, most native groups have a higher cognitive ability than immigrant groups, with the exception of British whites and other whites. With regard to non-cognitive skills, the average non-cognitive ability for the entire sample is 63.3. Immigrant British whites and native mixed separately have the highest and second highest average of non-cognitive skills, and native British whites are third. On average, immigrant groups perform worse in non-cognitive abilities, with the exception of British whites. The cross-group range of cognitive and non-cognitive abilities is 12.5 and 3.8, suggesting that cognitive ability is more dispersed than non-cognitive. The summary statistics of other variables are also shown in Table 5.3 and Table 5.4. Specifically, in terms of spatial differences in income levels, the variables related to residential areas are also included in this analysis.

Table 5.3: Summary statistics for whole sample and native ethnic groups

	Whole Sample	Native British White	Native Other White	Native Mixed	Native Asian	Native Black	Native Other
Percentage of Observation	100.00%	78.54%	2.62%	1.16%	2.98%	1.38%	0.22%
Continuous Variable							
ln(income)	9.8634	9.8647	9.8603	9.862	9.851	9.861	9.85
Growth of ln(income)	0.0004	0.0002	0.0000	0.0025	0.0031	0.0014	0.0026
Cognitive	62.0	63.2	61.9	62.4	57.7	56.8	60.1
Non-cognitive	63.3	63.6	63.5	63.9	62.5	63.2	62.8
Age	43.3	44.0	45.0	38.0	33.1	41.3	37.1
Category Variable							
Living in Urban Area	75.72%	72.41%	56.41%	93.55%	98.13%	99.01%	95.73%
Reside in England	77.73%	75.52%	36.40%	92.55%	96.83%	98.78%	90.05%
Reside in Walse	6.72%	7.93%	3.50%	2.64%	1.62%	0.46%	4.74%
Reside in Scotland	9.28%	10.96%	2.57%	3.45%	1.55%	0.76%	5.21%
Reside in North Ireland	6.26%	5.60%	57.53%	1.36%	0.00%	0.00%	0.00%
Male	42.24%	42.35%	43.23%	37.09%	45.40%	34.42%	39.15%
Edu (without qual)	4.94%	4.56%	10.53%	0.64%	1.83%	1.82%	0.94%
Edu (with qual)	6.92%	6.90%	7.39%	2.82%	2.75%	4.79%	6.60%
Edu (A level or GCSE)	41.49%	43.95%	37.81%	41.09%	47.51%	40.12%	41.98%
Edu (with degree)	46.65%	44.58%	44.27%	55.45%	47.90%	53.27%	50.47%
Very Poor language proficiency	0.07%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%
Poor language proficiency	0.30%	0.06%	0.00%	0.00%	0.35%	0.00%	0.00%
Fair language proficiency	2.14%	0.54%	2.21%	0.36%	2.47%	0.91%	2.83%
Good language proficiency	16.25%	13.13%	15.19%	12.64%	28.96%	19.76%	14.15%
Excellent language proficiency	81.24%	86.24%	82.60%	87.00%	68.22%	79.33%	83.02%
Medu (left school)	2.58%	0.26%	0.44%	1.64%	21.16%	1.22%	6.13%
Medu (left school)	34.01%	34.73%	48.29%	23.27%	36.58%	26.52%	22.64%
Medu (with quals)	34.76%	36.54%	26.40%	27.64%	26.42%	31.31%	40.09%
Medu (post school quals)	19.64%	20.15%	18.32%	26.09%	9.07%	30.78%	18.40%
Medu (uni or higher degree)	9.01%	8.32%	6.55%	21.36%	6.77%	10.18%	12.74%
Fedu (not go to school)	1.66%	0.42%	0.56%	3.91%	13.23%	4.48%	5.66%
Fedu (left school)	32.76%	34.10%	50.94%	19.18%	34.22%	29.64%	22.64%
Fedu (with quals)	24.88%	24.45%	18.52%	25.00%	29.59%	25.46%	14.62%
Fedu (post school quals)	27.67%	30.11%	19.65%	23.18%	10.41%	26.90%	27.36%
Fedu (uni or higher degree)	13.03%	10.91%	10.33%	28.73%	12.56%	13.53%	29.72%
Unemployed	4.33%	3.79%	5.75%	6.18%	7.90%	8.43%	4.25%
Self-employment	0.43%	0.41%	0.12%	0.45%	0.42%	0.38%	0.94%
Employee (unknown)	0.92%	0.82%	0.60%	1.64%	1.66%	2.13%	0.47%
Employee (managers)	12.68%	13.38%	11.81%	10.73%	10.19%	6.91%	7.55%
Employee (local)	12.44%	12.41%	12.41%	16.36%	10.65%	10.71%	16.04%
Employee (professions)	13.93%	14.25%	13.22%	15.55%	11.36%	16.79%	9.43%
Employee (administrative)	8.96%	9.32%	8.12%	7.55%	9.56%	10.94%	15.09%
Employee (trades)	5.83%	6.38%	5.42%	2.55%	1.48%	2.74%	2.83%
Employee (services)	7.66%	7.64%	8.28%	8.45%	6.28%	9.80%	1.89%
Employee (sales)	4.47%	4.39%	3.58%	6.55%	6.49%	6.76%	3.77%
Employee (operatives)	4.34%	4.29%	3.90%	0.36%	3.67%	3.34%	0.00%
Employee (elementary)	5.91%	5.83%	4.70%	3.82%	3.84%	5.02%	2.83%
Other economic activity	18.09%	17.10%	22.10%	19.82%	26.49%	16.03%	34.91%
Born in UK	86.89%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Years in UK (0 to 4)	0.30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Years in UK (5 to 9)	2.37%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Years in UK (more than 9)	10.43%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Job change	4.23%	3.83%	4.74%	5.36%	6.38%	7.52%	7.08%
Number of conversion jobs	11.45%	10.58%	12.13%	14.36%	15.63%	18.47%	16.51%

Table 5.4: Summary statistics for immigrant ethnic groups

	Immigrant British White	Immigrant Other White	Immigrant Mixed	Immigrant Asian	Immigrant Black	Immigrant Other
Percentage of Observation	1.83%	2.72%	0.49%	5.54%	1.98%	0.54%
Continuous Variable						
ln(income)	9.8712	9.8718	9.8675	9.8527	9.8527	9.851
Growth of ln(income)	-0.0006	0.0001	0.0014	0.0006	0.0012	0.0039
Cognitive	64.3	62.1	58.5	53.1	51.8	55.4
Non-cognitive	64.0	63.4	63.4	60.2	61.7	62.7
Age	44.5	41.9	42.2	41.9	42.2	40.2
Category Variable						
Living in Urban Area	70.50%	79.51%	91.61%	98.25%	97.29%	94.77%
Reside in England	80.97%	82.22%	95.48%	95.94%	97.88%	92.83%
Reside in Walse	4.83%	2.82%	0.00%	2.01%	0.74%	3.88%
Reside in Scotland	9.43%	6.57%	3.87%	1.73%	1.38%	1.94%
Reside in North Ireland	4.77%	8.39%	0.65%	0.32%	0.00%	1.36%
Male	45.36%	36.36%	32.90%	45.33%	38.94%	45.74%
Edu (without qual)	2.47%	4.44%	1.94%	11.92%	5.46%	8.53%
Edu (with qual)	5.28%	11.04%	7.53%	9.32%	5.68%	9.11%
Edu (A level or GCSE)	35.55%	16.52%	30.54%	26.51%	32.20%	16.47%
Edu (with degree)	56.71%	68.00%	60.00%	52.26%	56.66%	65.89%
Very Poor language proficiency	0.00%	0.62%	0.00%	0.27%	0.27%	0.78%
Poor language proficiency	0.34%	1.54%	0.00%	2.83%	1.06%	3.29%
Fair language proficiency	0.75%	11.54%	9.46%	15.58%	10.03%	22.67%
Good language proficiency	10.55%	29.91%	23.87%	40.97%	35.54%	24.42%
Excellent language proficiency	88.36%	56.39%	66.67%	40.36%	53.10%	48.84%
Medu (left school)	1.09%	1.27%	10.32%	20.89%	16.82%	16.09%
Medu (left school)	21.10%	19.92%	27.96%	34.14%	30.08%	25.78%
Medu (with quals)	39.91%	32.92%	22.80%	26.00%	22.55%	21.90%
Medu (post school quals)	24.31%	28.10%	16.56%	9.26%	19.52%	18.99%
Medu (uni or higher degree)	13.59%	17.79%	22.37%	9.72%	11.03%	17.25%
Fedu (not go to school)	0.92%	1.00%	3.23%	9.73%	8.28%	7.95%
Fedu (left school)	18.41%	19.92%	17.20%	26.11%	21.49%	19.38%
Fedu (with quals)	25.57%	27.52%	21.94%	29.17%	28.17%	25.58%
Fedu (post school quals)	31.54%	24.62%	19.14%	13.30%	16.60%	16.67%
Fedu (uni or higher degree)	23.57%	26.94%	38.49%	21.69%	25.46%	30.43%
Unemployed	3.50%	3.74%	5.38%	6.09%	9.81%	8.33%
Self-employment	0.52%	0.69%	1.51%	0.66%	0.42%	0.58%
Employee (unknown)	0.86%	1.00%	0.65%	1.50%	1.86%	0.39%
Employee (managers)	15.83%	13.32%	11.18%	8.77%	5.31%	5.04%
Employee (local)	15.14%	16.48%	12.47%	12.22%	7.27%	12.79%
Employee (professions)	13.59%	13.78%	16.77%	10.38%	13.90%	11.63%
Employee (administrative)	9.12%	7.53%	8.82%	5.69%	5.78%	5.43%
Employee (trades)	5.62%	4.82%	4.09%	4.02%	2.65%	5.04%
Employee (services)	7.28%	7.76%	6.24%	6.15%	14.43%	3.88%
Employee (sales)	3.27%	2.86%	1.72%	5.31%	4.77%	3.88%
Employee (operatives)	4.53%	4.86%	5.59%	6.58%	3.61%	5.23%
Employee (elementary)	4.76%	8.30%	9.03%	6.70%	10.29%	8.14%
Other economic activity	16.00%	14.86%	16.56%	25.92%	19.89%	29.65%
Born in UK	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Years in UK (0 to 4)	0.34%	2.93%	2.37%	2.75%	2.02%	2.71%
Years in UK (5 to 9)	2.06%	25.05%	17.85%	19.85%	18.30%	19.19%
Years in UK (more than 9)	97.59%	72.02%	79.78%	77.40%	79.68%	78.10%
Job change	3.56%	4.71%	5.16%	5.88%	7.48%	5.81%
Number of conversion jobs	9.40%	12.66%	12.26%	15.18%	19.20%	18.60%

5.5.2 Joint distribution of income and ability

The distribution of key variables used in this research is further depicted through the scatter plot. Figure 5.1 and Figure 5.2 show the distribution between income and cognitive ability for native and immigrant ethnic groups. The logarithm of monthly income roughly ranges from 9.8 to 9.95 for native groups, while the range of income for immigrant groups appears slightly broader. Among 12 groups, only four groups are evenly distributed on income (native mixed, native black, native others, and immigrant mixed). Among other 8 groups, five are with unimodal distribution (native other white, native Asian, immigrant Asian, immigrant black, and immigrant others), while the other three are bimodally distributed (native British white, immigrant British white and immigrant other white). On the other hand, cognitive ability roughly ranges from 25 to 75. Cognitive ability seems to be concentrated on the higher level (around 50 to 75) for eight groups (native British white, native other white, native Asian, immigrant British white, immigrant other white, immigrant Asian, immigrant black, and immigrant others), while distributed more evenly for the rest four groups. However, the bi-variate distribution between income and cognitive ability exhibits neither positive nor negative correlation.

Distribution between income and non-cognitive ability is displayed in Figure 5.3 and Figure 5.4. The distribution of income is identical to that illustrated in Figure 5.1 and Figure 5.2. The major part of non-cognitive ability roughly ranges from 50 to 75, where the range is slightly narrower than cognitive ability. Among 12 groups, the non-cognitive ability is evenly distributed for six groups (native British white, native other white, native mixed, native black, native others, and immigrant other white), while distribution of the other six is concentrated on some parts between 50 and 75. None of the positive or negative correlations between income and non-cognitive ability can be clearly observed by the joint distribution of income and non-cognitive ability.

Figure 5.5 and Figure 5.6 show the two-way distribution between income growth and cognitive ability, in grid of 12 ethnic groups. Growth of income mainly ranges around 0.000 for most groups, while the native others and immigrant others both perform a more dispersed scope on the growth of income. Five of twelve groups (native mixed, native Asian, native black, immigrant mixed, and immigrant black) shows even distribution on the growth of income, while the other seven groups appear to concentrate on 0.000. However, it only shows little difference in income growth by comparing the identical ethnicity between natives and immigrants. Seven of twelve groups (native British white, native other

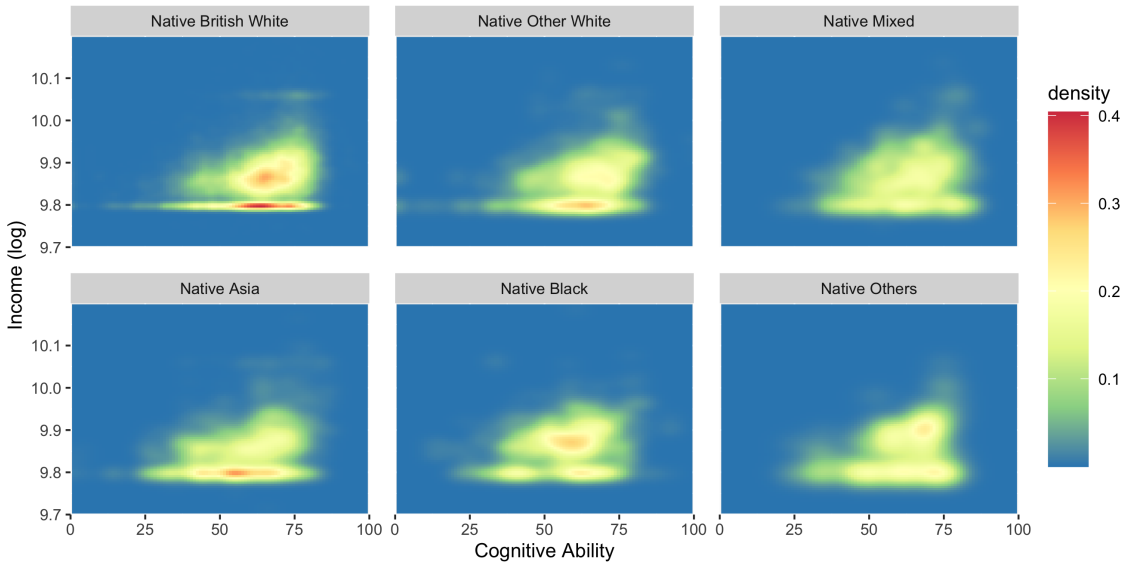


Figure 5.1: Income and Cognitive Ability (Native Ethnics)

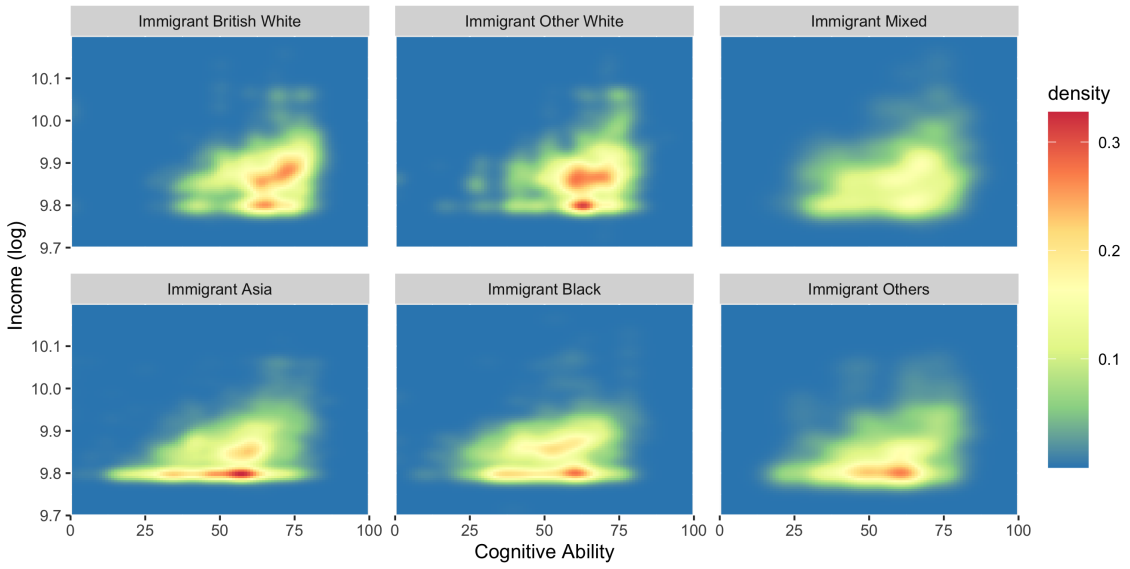


Figure 5.2: Income and Cognitive Ability (Immigrant Ethnics)

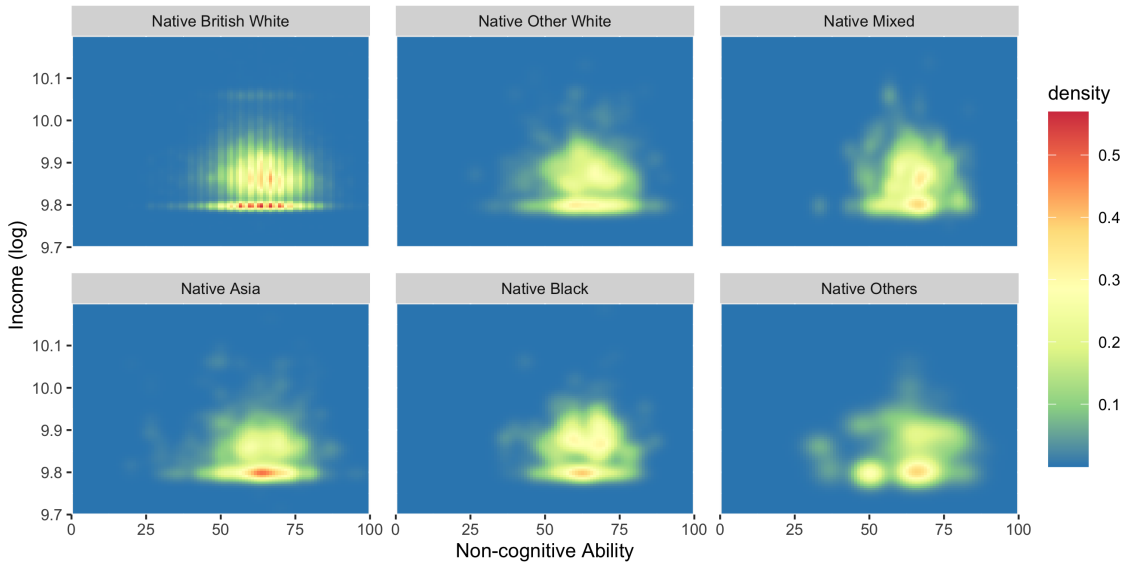


Figure 5.3: Income and Non-cognitive Ability (Native Ethnics)

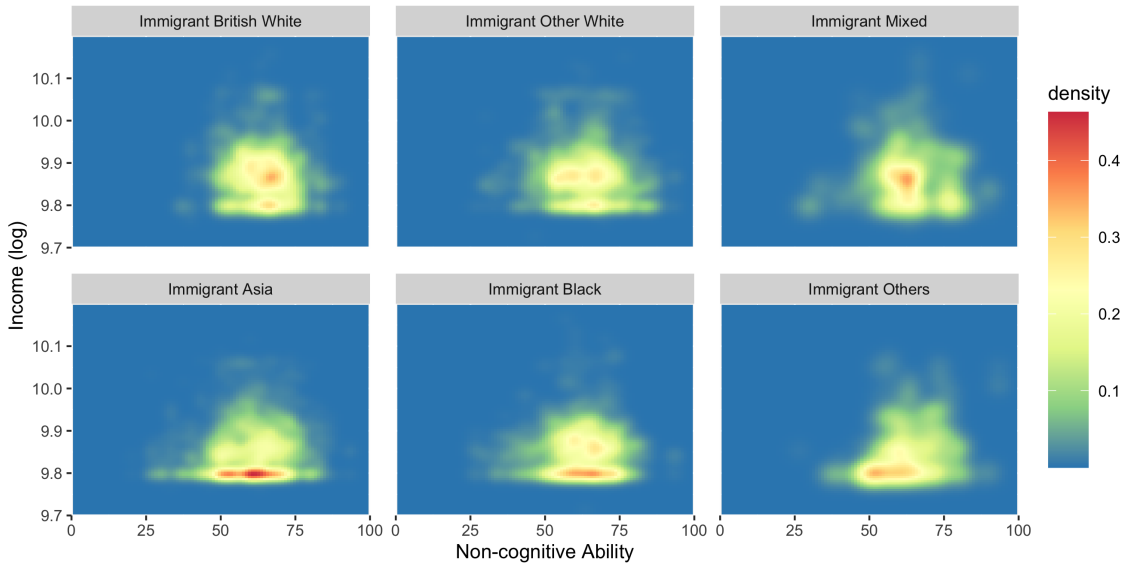


Figure 5.4: Income and Non-cognitive Ability (Immigrant Ethnics)

white, native other, immigrant British white, immigrant other white, immigrant Asian, and immigrant others) shows more concentration on the higher part of cognitive ability (50 to 75), while the other five groups exhibit a more uniform distribution ranging from 25 to 75. Nevertheless, Figure 5.5 and Figure 5.6 do not show a clear signal for a positive or negative correlation between income growth and non-cognitive abilities.

Joint distribution of income growth and non-cognitive ability for twelve groups is shown by grid in Figure 5.7 and Figure 5.8. The range of non-cognitive ability is mainly located between 50 and 75, while the range is slightly wider for four groups (native Asian, native others, immigrant Asian, and immigrant others). Among twelve groups, seven groups perform more concentration on some parts between its range of non-cognitive ability (native British white, native other white, native Asian, native others, immigrant British white, immigrant Asian, and immigrant others), while the other five has a more uniform distribution. Similarly, Figure 5.7 and Figure 5.8 do not reveal clear correlation between income growth and non-cognitive ability.

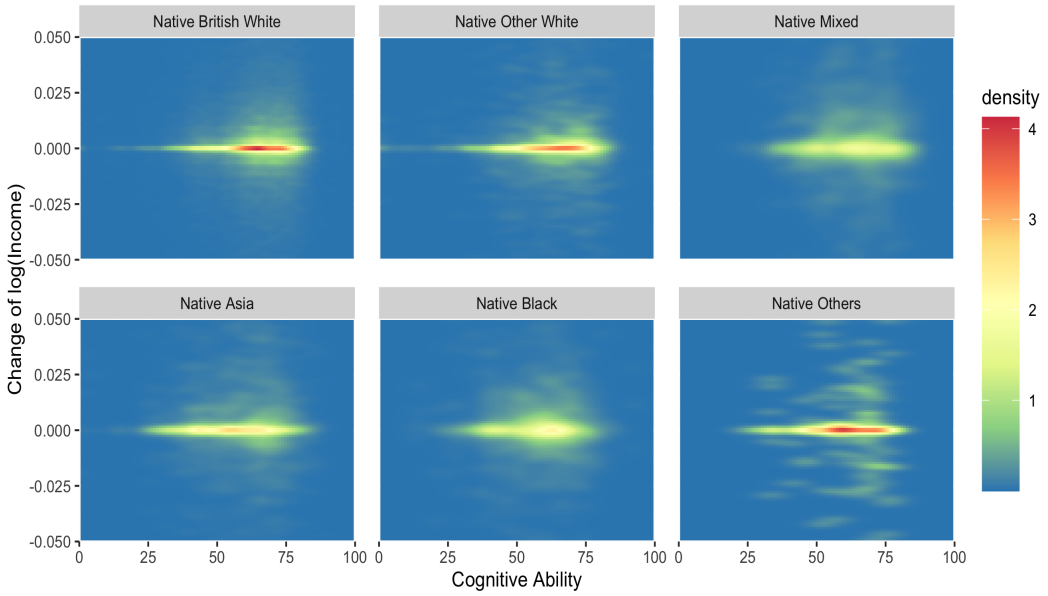


Figure 5.5: Income Growth and Cognitive Ability (Native Ethnics)

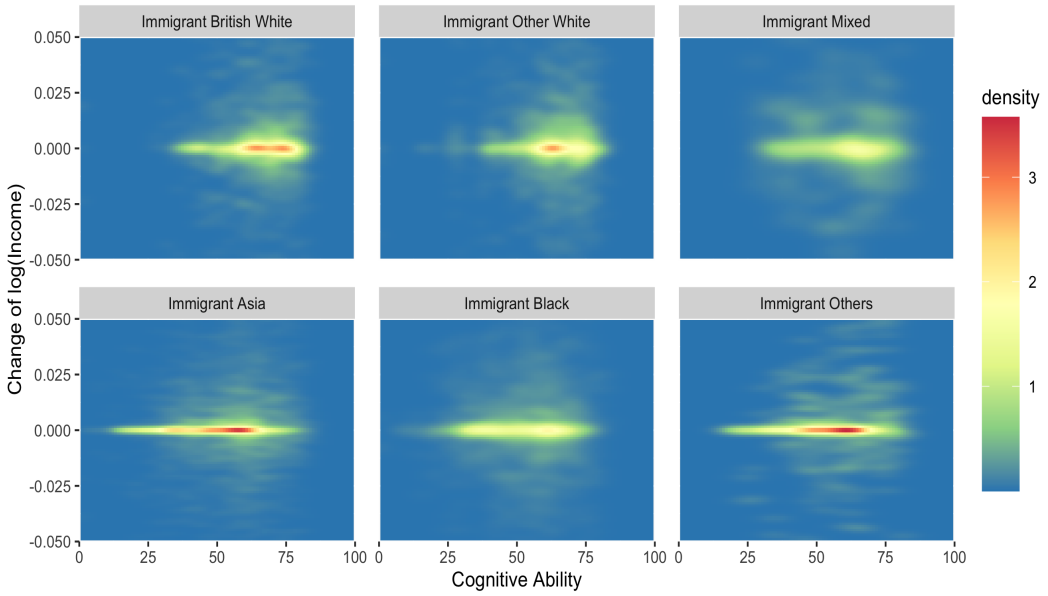


Figure 5.6: Income Growth and Cognitive Ability (Immigrant Ethnics)

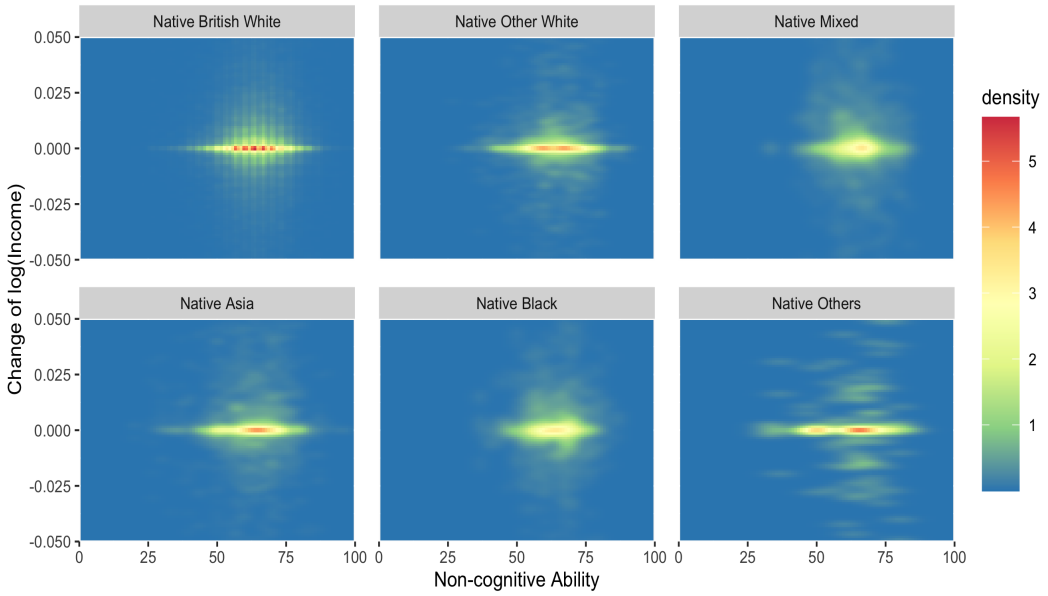


Figure 5.7: Income Growth and Non-cognitive Ability (Native Ethnics)

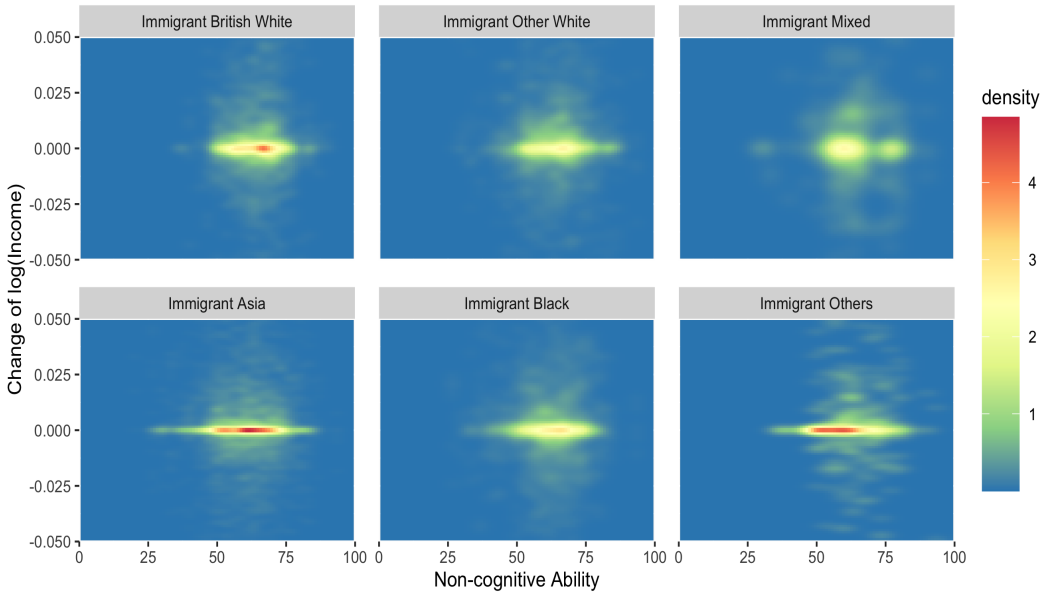


Figure 5.8: Income Growth and Non-cognitive Ability (Immigrant Ethnics)

5.5.3 Empirical results

Income model

The fixed effect and the random effect between both ability and income, which are evaluated through Equation (5.2) and the setting of a multilevel model, are shown in the first column of Table 5.5, Figure 5.9 and Figure 5.10 respectively. From the results of the income model in Table 5.5, the intercept is 9.713, representing the mean monthly income (in terms of log pounds after shifting the distribution of monthly income to a positive lower bound) for all observations. However, from (a) in Figure 5.9 and 5.10, even if the intercepts of income fluctuate from zero, none of them is statistically significant. This suggests that there is no variation in the baseline of average monthly income across waves and groups. This finding may be explained by our use of real income, adjusting the nominal income by the Consumer Price Index. In particular, variables related to 'years in the UK' do not significantly affect integration. This means that in our study, immigrants do not have a significant income gap with those who are native. They could integrate very well into the UK labour market. In terms of language abilities, we have found out that language ability does not have a significant impact on integration. The possible explanations are that due to the UK becoming linguistically diverse and many people are bilingualism and multilingualism [222], English ability alone does not significantly affect one's income.

In addition, the significant positive coefficient of cognitive ability in Table 5.5 is 0.0002. It implies that the increase of 0.0002 for log (income + 17,979) is caused by a unit increase in cognitive ability, which can be translated into a 0.02 % increase for (income + 17,979). An equation for calculating the volume of income change can be shown as follows: $income\ change{=}0.0002{*}income + 3.5958$. The change in income in response to changes in cognitive ability is exactly a function of income itself. This finding is supported by Zax and Rees [444]. However, the variation in the impact of cognitive ability on income between waves and groups does not differ significantly from zero, suggesting that the impact of cognitive ability on income is not related to time and ethnicity.

In terms of non-cognitive ability, non-cognitive ability does not have a significant impact on income when taking into account all observations. This results are consistent with the evidence suggesting that cognitive ability is the most important determinant of labour market outcomes (e.g., [214]). However, in regard to the variation in the influence of non-cognitive ability on income between waves and groups, we note that the random effects of non-cognitive differ significantly from zero across six waves and most groups, with the only

exception of immigrant mixed and native others groups. First, the random coefficient of non-cognitive ability is positive for the later three waves, but negative for the former three waves, which shows two distinctive types of impact on income at different time periods, though economically insignificant. Second, the impact of non-cognitive abilities on income is ethnically dependent. Non-cognitive ability is likely to be the factor that explains income inequality between different groups. The effects are statistically significant, but they are economically insignificant.

Income growth model

The fixed and random effect between income growth, cognitive and non-cognitive abilities estimated by Equation (5.8) is shown in the second column of Table 5.5 and the three caterpillar plots in Figure 5.11 and Figure 5.12, respectively. From Table 5.5, the intercept, which means that the average income growth of all observations between the waves is 0.008. Besides, (a) in Figure 5.11 also shows that the average income growth of each wave does not vary significantly, and (a) in Figure 5.12 does not show any significant discrepancies in income growth between groups.

Table 5.5 shows no significant effect of cognitive ability on income growth. The results from (b) in Figure 5.11 are not suggestive of a significant impact of cognitive ability on income growth, with no evidence to suggest that the influence of cognitive ability on income growth varies by waves. Observed from (b) of Figure 5.12, there is no significant difference in the effects of cognitive ability on income growth in different groups, with the only exception for immigrant British white and native Asian.

The average impact of non-cognitive ability on income growth is insignificant, while the random effect coefficients of non-cognitive ability represented in (c) of Figure 5.11 and Figure 5.12 show some discrepancy on the effects across waves and groups. (c) of Figure 5.11 reveals that non-cognitive would have a positive effect on income growth at Wave 6, while having a negative effect at Wave 8. The different composition of the observations can have different effects. This might be explained by the overlapping years across waves and the fluctuation of immigrant employment from Europe across waves. Due to the different composition of observations, the impact mat be vary. According to the data published by Office for National Statistics, proportion of migrant labour from Europe keep growing during 2010 and 2017, but it encounters a drop in 2018 (from 47.0% in 2017 to 45.1% 2018), which is exactly the third year covered in Wave 8 (2016-2018). Also, the Wave 6 covers

from 2014 to 2016, and the ratio of migrant labour from Europe has faced a relatively significant increase in 2015 (rise from 43.5% in 2014 to 45.5% in 2015).

Alternatively, the results in the (c) of Figure 5.12 exhibit that the impact of non-cognitive on income growth is various across groups. The impact is statistically significant, but economically insignificant. The impact of non-cognitive on income growth vary by group, mainly due to the fact that the different experiences and characteristics of ethnic minorities lead these groups on different career paths [206, 63]. Different professions emphasise different skills. The service sector, for example, requires non-cognitive skills more than other occupations. Moreover, employers in low-skilled labour markets tend to rate non-cognitive skills higher than cognitive skills [319]. In addition, the non-cognitive ability is indeed an aggregated concept in this study, and this ability is measured by the average of several dimensions (the big five personality traits). However, each dimension could have a different impact on income or income growth. According to Nejad and Schurer [325], immigrants are able to translate some of their favourable personality traits into higher incomes, while translating non-favourable others into lower incomes. For example, in their study, it was found that 'openness to experience' has a negative impact on earnings, while 'agreeableness' has a positive impact.

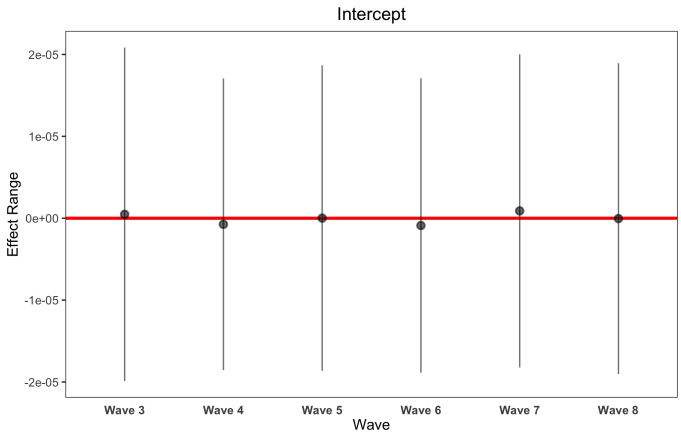
Among these groups, four groups (with descending rank by magnitude: immigrant British white, immigrant black, native British white, and immigrant other white) have positive influence of non-cognitive ability, while other eight groups have negative effect. Native British white has a smaller positive effect than immigrant British white. Immigrant groups tend to have a lager effect on income growth than native groups. For example, immigrant black has a positive effect, while native black has a negative effect, and the negative effect of immigrant others is closer to zero than native others. Within the native groups, British whites are the only with positive effects, and Asians have the greatest negative effects, while black, mixed, others, and other white are ranked ascendingly with negative effect. When turning to immigrant groups, British white, black, and other white have positive effects which are ranked descendingly, and Asian, others, and mixed have negative effects, whose sizes range from large to small.

Table 5.5: Results of fixed effect- Income model and Income growth model

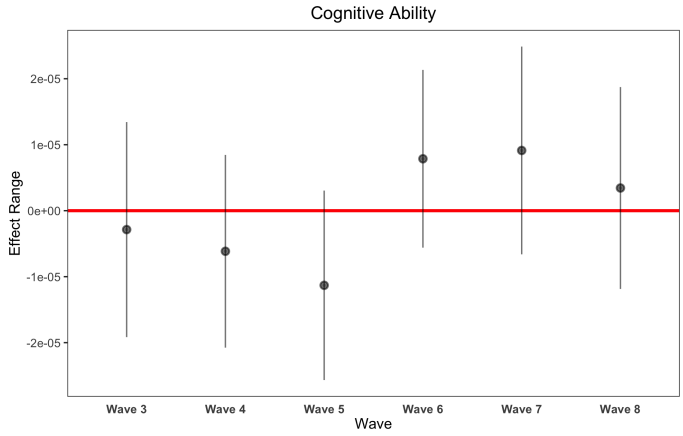
	Income Model	Income Growth Model
Constant	9.71332***	0.00782
Cognitive	0.00022***	-0.00004
Non-cognitive	-0.00004	-0.00003
Age	0.00253***	-0.0009***
Age Square	-0.00003***	0.00001***
Living in Urban Area	0.0006	0.00065
Reside in Walse	-0.00379***	0.00075
Reside in Scotland	-0.00047	0.0002
Reside in North Ireland	-0.00256***	0.00054
Male	0.01924***	-0.00174***
Edu (with qual)	-0.00088	-0.00294
Edu (A level or GCSE)	0.00203	-0.00427***
Edu (with degree)	0.01076***	-0.00538***
Poor language proficiency	0.00596	-0.00167
Fair language proficiency	0.00135	-0.00282
Good language proficiency	0.00546	-0.00325
Excellent language proficiency	0.00714	-0.00364
Years in UK (0 to 4)	-0.00624	0.00323
Years in UK (5 to 9)	-0.00093	0
Years in UK (more than 9)	0.00115	-0.00008
Medu (left school)	0.00211	-0.00136
Medu (with quals)	0.00403***	-0.00192
Medu (post school quals)	0.00429***	-0.00153
Medu (uni or higher degree)	0.00453***	-0.00161
Fedu (left school)	0.00327	-0.00018
Fedu (with quals)	0.00244	-0.00019
Fedu (post school quals)	0.00296	-0.0004
Fedu (uni or higher degree)	0.00736***	-0.00002
Self-employment	0.01213***	-0.01721***
Employee (unknown)	0.04509***	0.01472***
Employee (managers)	0.09953***	0.03354***
Employee (local)	0.0997***	0.03451***
Employee (professions)	0.08023***	0.03373***
Employee (administrative)	0.06383***	0.03263***
Employee (trades)	0.06736***	0.03319***
Employee (services)	0.05425***	0.03243***
Employee (sales)	0.04879***	0.03179***
Employee (operatives)	0.06508***	0.03284***
Employee (elementary)	0.04951***	0.0324***
Other economic activity	0.00636***	0.01974***
Job change	-0.00147	0.00571***
Number of conversion jobs	-0.00511***	0.00628***
Observations	95,117	74,829
AIC	-284,098	-187,594
BIC	-283,577	-187,086

[1] Estimates with stars are those statistically significant, where *, **, and *** respectively indicates the p-value to be smaller than 0.1, 0.05 and 0.01.

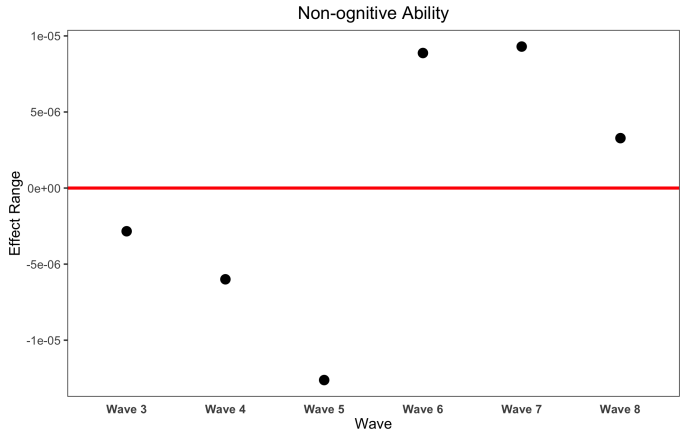
[2] Standard deviation for cognitive ability in Income Model and Income Growth Model are respectively 2.2×10^{-5} and 2.7×10^{-5}, and standard deviation for non-cognitive ability in Income Model and Income Growth Model are respectively 4.0×10^{-5} and 4.2×10^{-5}.



(a) Intercept

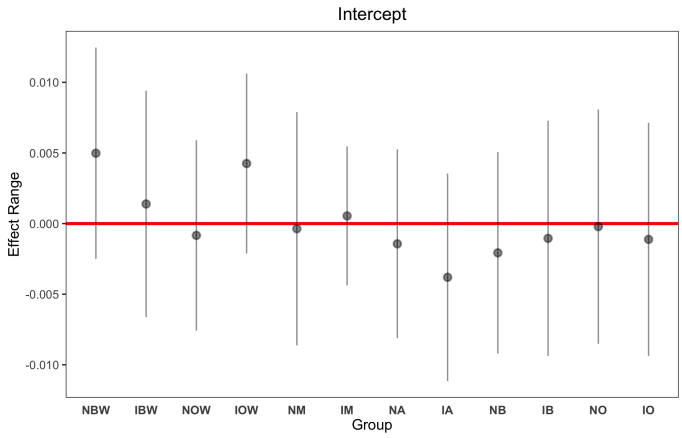


(b) Cognitive ability

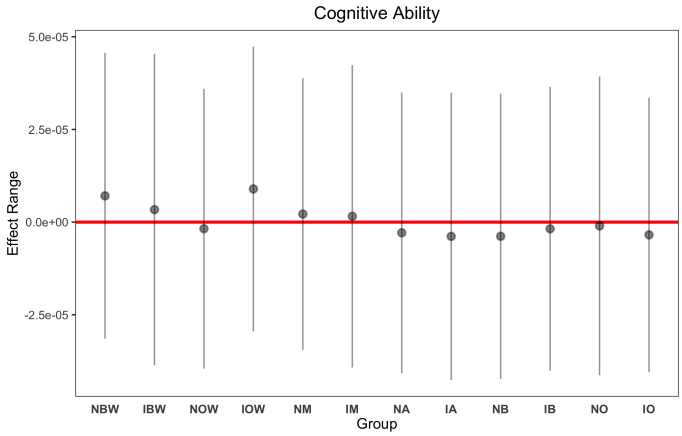


(c) Non-cognitive ability

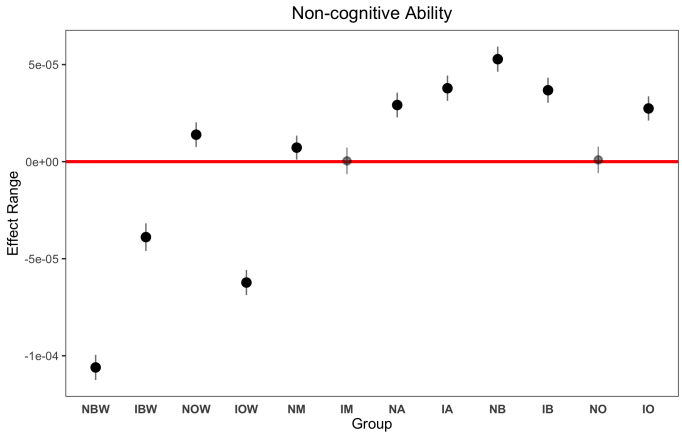
Figure 5.9: Random Effect of Income Model (across Wave)



(a) Intercept

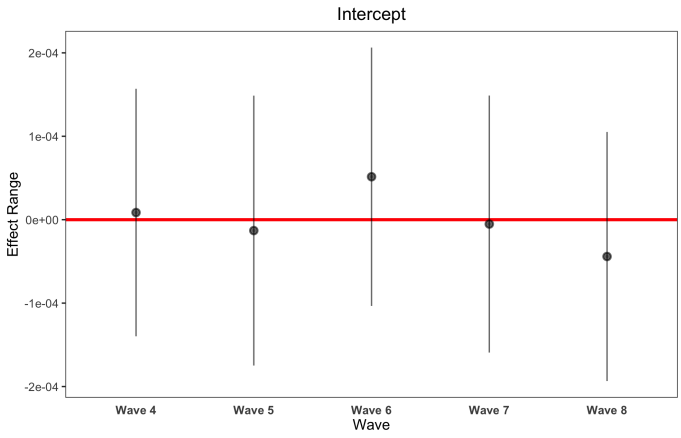


(b) Cognitive ability

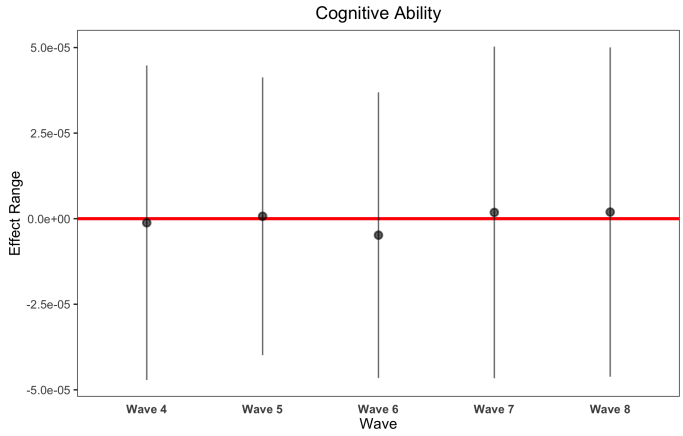


(c) Non-cognitive ability

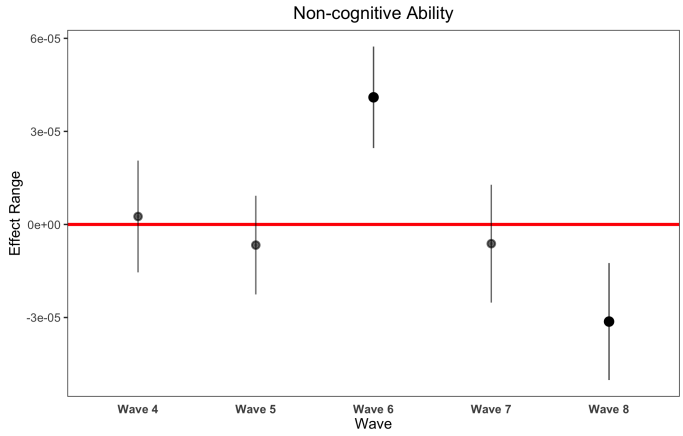
Figure 5.10: Random Effect of Income Model (across Group)



(a) Intercept

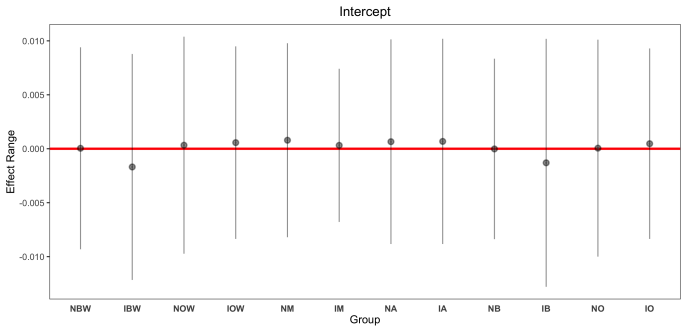


(b) Cognitive ability

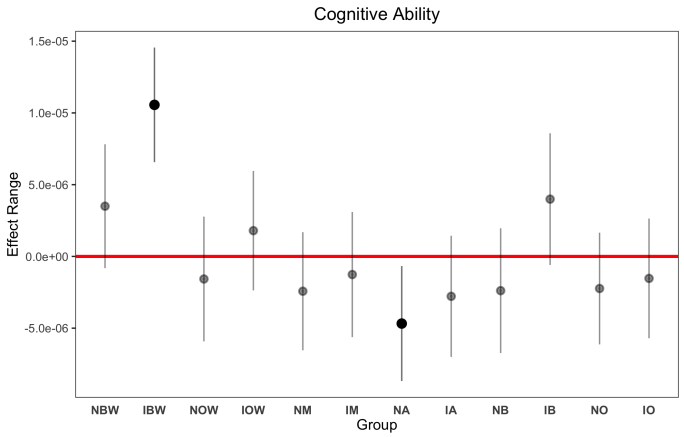


(c) Non-cognitive ability

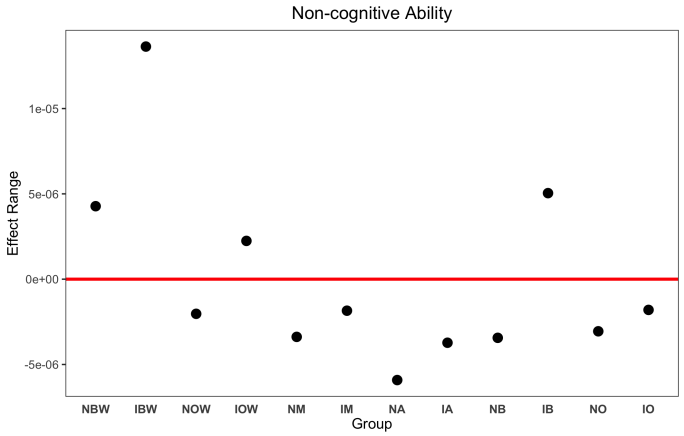
Figure 5.11: Random Effect of Income Growth Model (across Wave)



(a) Intercept



(b) Cognitive ability



(c) Non-cognitive ability

Figure 5.12: Random Effect of Income Growth Model (across Group)

5.6 Conclusion

Immigration in the United Kingdom has been increasing over the two last decades, especially amongst working age populations. Yet experiences of integration for different migrant groups from diverse backgrounds varies markedly. Labour market integration is importance because it is arguably the main pathway to full integration. From one perspective, non-cognitive abilities such as endurance, motivation, emotional stability, or social ability are equal or more important for the labour outcome. An alternative view is that cognitive ability is the most important determinant of labour market outcomes (e.g., [214]). Besides, evidence have shown that cognitive is important for the immigrant integration into labour market. Yet, little progress has been made in understanding the various association between non-cognitive ability and immigrant integration among different ethnic groups. This study sought to empirically assess the influence of non-cognitive ability on immigrant integration into labour market (measured by income and income growth), examine variations across groups.

Unlike previous studies, our study takes into account two aspects of the integration of immigrants into the labour market: the income gap and the difference in income growth between native and foreign-born individuals. From our data, there is no significant correlation between income and income growth between different groups of people. There are two main findings in our study. First, our findings showed that cognitive ability correlates positively and significantly with income on average, even if a large number of personal characteristics, job-related dimensions, and immigrant-related variables are controlled. The results are supported by Crouse [111]. Crouse [111] found that wages increase by nearly 15% if cognitive ability scores increase a standard deviation by using Michigan individual schooling test results. In addition, based on the data in Germany, Anger and Heineck [15] also found that cognitive skills play an important role in determining wages, even after controlling personal characteristics, education levels, and job-related attributes. Moreover, We has also found that the impact of cognitive ability on income is invariant across different groups. In other words, the economic return of cognitive skills is likely to be the same in different groups.

Compared to the impact of cognitive skills on the income of individuals, the impact of non-cognitive skills on income is insignificant in this study. This finding is consistent with that of previous studies - even if there is a positive relationship between non-cognitive and labour-market outcomes, the positive impact of personality traits on income is observed

only to a limited extent compared to the level of economic return on cognitive skills (see [73]). However, non-cognitive skills play a role in explaining income inequality between different groups. The returns of non-cognitive skills vary between groups.

Second, overall, neither cognitive nor non-cognitive skills play a role in explaining income growth. However, in terms of unequal income growth between groups, the influence of cognitive and non-cognitive skills on income growth between groups is varied.

In summary, both cognitive skills and non-cognitive skills are important for labour market integration. Overall, cognitive skills have a significantly positive impact on income. In terms of labour market integration between groups, cognitive skills also play a role in explaining the difference in income growth between different groups. On the other hand, non-cognitive skills play a role in explaining income inequality between groups and the difference in income growth between groups.

Chapter 6

Conclusion

6.1 Introduction

Immigration in the past has been and will in the future remain as a primary feature of social structures and societies [230]. The social integration of immigrants has become a critical element of integration. The education system in the destination country represents an extraordinary context in which to promote the integration of second-generation immigrants [61]. According to American educational historians, they pointed out that one of the most important functions of common schooling was the socialisation of immigrants in American life and culture [247]. Besides, the relationship between immigrant's education level and labour market outcome is well documented in previous research. Racial and ethnic inequalities in immigrants' income growth are explained by the differences in education levels and skills of immigrants (e.g., [52, 54]). Immigrants with higher income in turn increase their ability to interact more fully with the society in which they live. Therefore, one of the most important aspects to focus on is the integration of immigrants into the education system.

In the wake of the new century, global, national, and European research bodies have increasingly become aware of the integration phenomenon of migrant children into the education system of European societies and have produced a wide body of results. Over this time, huge progress has been made in understanding the barriers affecting the learning process of immigrants and their academic performance. Previous research on the educational system integration of immigrant's children agree that immigrant children overall, underperform as compared to native students [22, 375, 234, 211]. For example, from indicators and

achievement tests of students, Heckmann [211] agrees that when primary school education ends, immigrant children attain significantly lower marks compared to native students.

With research having identified the overall low performance of immigrant children, research has also sought out to establish the barriers such children face to better academic performance [171, 405, 195, 328, 355, 274]. Lemu [274], for instance, established that better academic performance in school has a direct correlation to the assistance parents offer to their children, and academic assistance is an aspect most immigrant parents are incapable of. Separate studies by researchers like Fuligni [171], also suggest that immigrant children undergo several challenges that prevent them from performing the same as native children, with a majority of such challenges relating to the circumstances their families undergo. As mentioned by Lemu [274], some these circumstances include inadequate language skills of the host country, the settlement of immigrant families into the host societies, arrival from war-torn countries with limited resources, and inadequate knowledge to navigate the educational systems of the host countries. Previous research has also identified the fact that immigrant parents have less economic and social capital as compared to native parents, and this, in line with research, affects children in the sense that their parents may not be in a position to support their children [274]. There are several structural challenges for immigrant children including discrimination (xenophobia, which may be in form of racism) and community violence.

However, despite such interesting findings, this body of research is not without gaps and deficiencies. A majority of these studies have only compared children in immigrant households against those with two parents. Notwithstanding, there are only a few studies comparing children from all households at the same time. In essence, what has been lacking is a detailed comparison of the academic performance of children from all household structures. In addition, a number of studies pertaining to the academic performance of children from immigrant performance emphasise on children with one immigrant parent and another native parent [169, 197, 409, 436]. Such research involves children with immigrant mothers and native fathers. In a country like Taiwan, a majority of children in immigrant households have an immigrant mother and a native father. Notwithstanding, as a result of the existence of the father, his effect on the academic performance of the child also exists. Thus, there is no basic way of simply judging the variance in the academic performance of the children, which is hugely influenced by the mother's nationality. Consequently, it has made it more challenging to prove that the better or worse academic performance of children in immigrant households is as a result of the influence from the immigrant mothers

or the native fathers.

Over the years, labour market integration has become a critical research facet, mainly due to the rising numbers of global migrants. Previous research shows common trends such as the different rates of labour market integration amongst different immigrant groups [384, 100, 42, 101, 99]. Clark and Lindley [101], for example, established that white and skilled immigrants are integrated faster compared to black and low skilled immigrants. Also, Kuptsch and Sparreboom [265] identify that the integration of immigrants into the labour market is influenced by factors such as inadequate skills, lack of skills (mainly language skills, and low levels of education and training), unrecognised qualifications in the host country, employment obstacles such as family responsibilities, housing challenges, health problems, employer discrimination, and legal responsibilities. Kuptsch and Sparreboom [265] also pointed out the significance of factors like low employment opportunities and reduced income for immigrants as compared to natives in determining how immigrants are integrated into the market. There is a line of research that has emphasised the role cognitive factors play in labour market integration, for instance, Hahn et al. [192] and Fernandez Macias and Paniagua [144] point out that cognitive factors will continue influencing the integration of immigrants into the host country's labour market. According to the same vein of research, the cognitive skills critical to immigrant integration include educational history cognitive ability, integration-course participation, language skills, amongst others [192].

Previous research on labour market integration is not without deficiencies and gaps. A majority of studies explaining the immigrant inequality phenomenon in the labour market attribute cognitive skills and abilities, for example, language proficiency, to the varying pace of immigrant integration. Research by Nejad and Schurer [325] establishes that cognitive skills will affect the integration pace of immigrants. However, there is a thin line of research regarding the role and the influence of non-cognitive skills in immigrant integration and how fast various immigrant groups are integrated into the labour market. Non-cognitive skills that can be broadly defined as personality traits or thought, feelings and judgment patterns [51]. However much the traditional theory of human capital emphasises on the role of schooling and the significance of cognitive abilities, researchers have started seeing the significance of non-cognitive abilities in labour productivity, which is seen to affect employees' marginal productivity [69, 290, 285]. From other researchers such as Segal [376], non-cognitive abilities improve the ability of individuals to amass human capital, and influence their occupation and specialization choices. This demonstrates the significance

of non-cognitive abilities and its role in immigrant labour market integration, and thus, the need to study this aspect in detail.

6.2 Summary of the main findings

In order to better understand the association of children's academic performance between different family structures and the extent of migration's integration into the education system and labour market integration, this study sought to achieve three specific aims:

1. To establish the comprehensive research on the academic performance of children of different household structures

2. To explore the impact of mother's nationality on children and how it differently affects children

3. To examine differences in the pace of integration between immigrant groups and determine the ways in which differences in cognitive and non-cognitive skills contribute to explain differences in the pace of migrant integration

6.2.1 The academic performance of children from different household structures

As pointed out by Li and Qiu [279], education is a lasting process, and academic performance in primary education plays a critical role in getting further educational opportunities. Education is the primary mechanism for enhancing the population quality of a country, and education during childhood is the basis for forming human labour-force quality [279]. Education not only impacts the happiness and achievement at the individual level, but also shapes the quality of the labour force and the innovation capacity to determine the possibility of developing a nation. Academic performance, according to Li and Qiu [279] may be rooted to factors such as institutional arrangement and the various capacities and opportunities families have in participation in education. Thus, in line with Li and Qiu [279], it is crucial to assess how family background affects the academic performance of children.

The aim of the first study in this dissertation (Chapter 3) is to evaluate the academic performance of children in different types of family structures in Taiwan. The test scores of

8th-grade children in traditional and non-traditional family structures are compared. Two-parent families are classified as traditional family structures, while single-parent, skipped-generation, and immigrant families are classified as non-traditional family structures. The reasons for classifying immigrants into non-traditional family structures are as follows: Taiwan was a relatively closed country before the early 1990s due to political conditions. It was not a common phenomenon for foreigners/immigrants from other countries who came to Taiwan and formed a family. As a result, there were rare and limited families with immigrants in Taiwan at that time. Over time, policy changes and the number of foreign brides are growing dramatically. Therefore, Taiwan has many immigrant families. Compared to traditional two-parent families, immigrant families are therefore a relatively new form of family structure in Taiwan. As a result, it is classified as a *non-traditional* family structure in this study.

The findings of the first study pointed out that, generally, children from immigrant families have no significant score gap than children from two-parent families. However, children from skipped-generation households are most disadvantaged academically. Children from two-parent households were associated with high academic test results, whereas children from single-parent families scored 4.6 points fewer. The results of the first study were in line with initial studies pointing out that children from less traditional family structures tend to portray reduced school achievements compared to children from two-parent families [301]. As found out by researchers such as Shields and Behrman [380] and Gornick and Jantti [182], such results are attributable to factors such as financial disadvantage, limited parental involvement, reduced financial muscle, lack of educational resources, all of which relate to less traditional family structures.

The study also established that children from single-parent households and skipped-generation households achieve lower compared to children from two-parent households across all the five disciplines of cognitive knowledge. On the contrary, children from immigrant households seem to attain the same scores as children from two-parent households, except for the English and Chinese. Their performance is poor in only English, while they perform better in Chinese. Such findings different than the research by OECD [152] on industrialised Western societies, which points out that immigrants' children tend to perform poorly in Science, Maths, and Reading. An explanation for such contradictory findings could be given that immigrants in Taiwan primarily come from China, and thus, share a common language. Language barriers, which primarily affect other immigrants' children, do not impede most immigrants in Taiwan.

The first study also found out that the poor academic performance of children from single-parent households and skipped-generation households are persistent over time. Children from single-parent households and skipped-generation households consistently attain scores of up to 9 points fewer than children from two-parent families. On the contrary, children from immigrant households showed a similar performance level compared to those from two-parent families as from 2010. This can be due to that Taiwan's society is more inclusive of ethnic diversity, which gives immigrants and their offspring more social support nowadays. For example, immigrants could be more likely to be supported by different communities, such as the support within communities that is generated by the growing number of immigrants. Also, a friendlier environment could be accessible to immigrant children in school, which can reduce their isolation and thus benefit their school lives.

6.2.2 The academic performance of children with immigrant mother of different nationality

A mother's nationality can be classified as one of the parent-related factors that assist in molding a child's lifestyle, attitude, and personality [166]. Other parent related factors that have been established by research include factors such as the education, income, guidance, and occupation of the parent. In line with Barlow et al. [32], when assessing parent-related factors it is important to analyse their incomes, their levels of education, occupations and guidance. Previous research has already established that parents carry a significant impact on children outcome [238]. In this line, a parent's nationality also has a direct correlation with parent-related factors, for instance, the educational level of parents, their income, and occupation, all of which ultimately affect the academic performance of children. For this reason, it was important to compare the academic performance of immigrant mothers on the performance of their children.

Moreover, international marriages have turned out to be an overall demographic trend globally, more so in East Asian societies. A country like Taiwan has witnessed a tremendous growth of international marriages in the last ten years, and have been followed by the increase of the number of 'new Taiwanese offspring'. Studying the educational outcomes of children from intermarriages is of specific significance as it points out the long-term implications of intermarriages. A lot of research has been carried out regarding the same, with existing literature emphasising on the educational gaps of immigrants' children largely revolving around the children of two-parent families.

Results of the second study pointed that test score gaps exist between children with immigrant single mothers and native single mothers after controlling the kid's personal characteristics and family background. In line with the findings, children with native mothers, and children of Mainland China mothers perform better compared to those with Southeast Asia and other immigrant mothers. This suggests that immigrant mothers whose native country share a similar language with the destination nation will have few language barriers compared to other immigrant mothers.

Furthermore, the score gap for children with mothers of different nationalities in all score quantiles is also assessed. The findings point out that the possible solutions of improving the performance of immigrants' children ought not to be only tailored to the mother's nation of origin but ought to vary in different quantities for children along the score distribution. For example, amongst children with Mainland China mothers, the notable test score gaps only appeared in the lower tail of the score distributions and disappeared in the upper and middle tail. Thus, variances across quantiles, ought to, thus, be considered before policies are implemented.

6.2.3 The impact of cognitive ability and non-cognitive ability on the pace of immigrants' integration into the labour market

As pointed out by Fernendez Macias and Paniagua [144], the person or entity tasked with deciding who will move abroad significantly affects the quality of immigrants arriving at the host country. Policymakers have a deep interest in the resulting pool of successful arrivals [144]. Consequently, this has led to a majority of popular destination countries opting for selective policies of immigration to increase the average quality of immigrants. Countries like Canada and Australia have implemented policies aiming to attract migrants with qualifications that are undersupplied in their local labour markets [144]. In such countries, admission depends on abilities such as language skills, educational levels, and occupational qualifications [144]. In line with Bertoli et al. [41], the qualities of migrants materialise in their motivations, character traits, and other innate capabilities. Both cognitive and non-cognitive abilities are more likely to affect how well immigrants are capable of and willing to follow the norms of, and to integrate into, the community of the host country [144], and for this reason, it was critical to assess the impact of both abilities on the pace of immigrants' integration into the labour market.

In addition, there is an emerging and limited literature exploring sources of ethnic gaps in non-cognitive. Most of them use US data and focus on the gap between black and white students [167, 137, 231]. Besides, for the second generation of immigrants, Nguyen et al. [326] is the first to compare the non-cognitive abilities of children of Asian immigrants and children of native-born Australian parents. They found the significant differences in non-cognitive ability development between children of Asian immigrants and parents from other ethnic groups. To our knowledge, no previous study relates to ethnic gaps of non-cognitive ability, discussing how non-cognitive ability influences one's labour market performance differently across various ethnic groups. This study thus provides the first evidence of ethnic gaps in both abilities (i.e., cognitive ability and non-cognitive ability) and how they influence the labour market performance of adults in the UK.

Contrary to Chapter 3 and Chapter 4, the third study of this dissertation (Chapter 5) focused on integration into the labour market. Income and income growth are the two key measures for investigating labour market integration. The findings pointed out that there is no significant correlation between income and income growth. Also, the findings pointed out that, generally, cognitive ability, averagely, significantly affect a person's income. With respect to unequal income growth between various groups, both cognitive and non-cognitive skills can explain the different income growth between various groups, while the scale is not economically significant. On the other hand, only non-cognitive abilities can explain income inequality between different groups, even if the extent of the impact is not economically significant. The return to non-cognitive ability varies between ethnic groups, but the scale is small. These results are mainly due to that the different experiences and characteristics of ethnic minorities lead these groups on different career paths [206, 63]. Different occupations emphasise different skills. For example, the service sector requires non-cognitive skills more than other occupations. Besides, in low-skilled labour markets, employers tend to rate non-cognitive skills higher than cognitive ones [319]. Besides, the non-cognitive ability is indeed an aggregated concept in Chapter 5, and this ability is measured through the average of several dimensions (the Big Five personality traits). However, each dimension might exhibit different influence on income or income growth. According to Nejad and Schurer [325], immigrants are able to translate some of their favourable personality traits into higher earnings, while translating non-favourable others into lower earnings. For example, in their study, it's found that 'openness to experience' brings a negative effect on earnings, while 'agreeableness' has a positive effect.

6.3 Contributions, implications and limitations

As mentioned by Hellgren [212], integration is seen as a two-fold process that is founded on the participation of immigrants and their children in major social institutions and systems like schools and the labour market, together with their social acceptance by the natives. The integration process consumes a lot of time, and previous research has majorly considered the process in two ways: for the first generation, by assessing what takes place in the time since arrival, and comparing them against the second generation [212]. With the support of previous research, this dissertation proved that integration into educational system of the host nation may make immigrants' children better off and place them in a better place to fully contribute to their communities, which is undoubtedly a major objective for the immigrants. Suppose immigrants went to a specific country with little education and become more like the native-born individuals by attaining more educational levels, one may conclude that they are more integrated. They may also be seen as better off since better education facilitates their well-being [212]. Also, immigrants themselves focus on being integrated into the labour system of the host country so that they are able to reap benefits such as better income and improve livelihoods for their families.

Founded on the same, this dissertation is structured and framed by a life course perspective. The integration of immigrants throughout their life is evaluated. For the education system integration, we put emphasis on the 8th grade immigrant children's cognitive development, which is characterised by test scores. According to cognitive development theory, children tend to be proactive in assimilating, learning and adapting their perceptions and new concepts when they interact actively with other people and the environment. As a result, environment and parents become critical components of children. Hence, tn our first and second studies in the dissertation, the impact of the family structure on children's academic performance and whether or not the nationality of parents has a significant impact on children's performance are investigated. On the other hand, cognitive and non-cognitive skills, based on human capital theory, justify certain labour and behavioral outcomes. We then examine the integration of immigrants into the labour market, which shows whether they are strongly integrated in middle age. Income and income growth are the two key measures used to assess their integration into the labour market.

This dissertation has made huge contributions that have major implications on two domains: substantive knowledge and policy. From the first study, with regard to policy, the study's findings point out that providing financial help to single-parent and skipped-

generation households is key to tackling the reproduction and social and economic inequality. Findings from this study would help in structuring the total allocated budget and the relevant subsidy packages to assist the less fortunate family structures, who are essentially the single-parent and skipped-generation households.

The findings of the second study have assisted in better exposing the issues regarding immigration and the education of immigrant children. The findings have helped identify the variations in the factors affecting the academic performance of children with native parents and children with immigrant single-mothers of various nationalities. The government and other non-governmental agencies may make use of these findings and variations to draw immigrant policies that would offer a fair advantage to the children with immigrant single-parent families. This would guarantee the effective integration of children despite the variations in their family backgrounds. In addition, the government could pay attention to the findings of the second study when putting in place favorable immigration policies or when subsidizing immigrant children.

The findings of the third study are especially significant in the context of a global shift toward conservative immigration policies. In specific nations, highly conservative, anti-migration parties have joined the political scene, for example, in the UK. Some of these parties have been successful in influencing the direction of a nation's immigration scheme via official representation in parliaments. As policymakers share deep concern about the resulting pool of successful immigrants, a number of popular destination nations will have selective immigration policies in place to improve immigrant quality [144]. In such context, the findings of the third study would be crucial in formulating these policies. Two points of empirical results in Chapter 5 jointly contribute to the formulation of selective immigration policies in the UK. Firstly, as cognitive ability increases, more income is generated from the labour market. Secondly, some of the immigration groups actually have lower cognitive abilities on average, e.g., immigrant Asian and immigrant black. It is likely that these immigrants are only eligible for employment opportunities with low skills and low pay due to their lack of good cognitive skills. As a result, imposing immigration policies that are selective in terms of applicant human capital (such as educational attainment or certification of skills) can not only prevent the inflow of potential workers with low quality, but also yield sufficient supply of productive factors to boost the economy.

This dissertation is not without limitations and it is therefore crucial to acknowledge some significant limitations in this dissertation. Most limitations are strongly related to data problems. First, the data set of Taiwan, which is utilised for our analysis in Chapter

3 and Chapter 4, contains only information of children from childhood to adulthood, and the school performance related information, excluding the information on one's later life (e.g., labour market performance). Therefore, we are not allowed to only use Taiwan's data set to assess immigrants' integration throughout their lives. Instead, the UK data set is applied in Chapter 5 of this dissertation to explore the labour market integration of immigrants. However, if Taiwan's data set can be combined with administrative data from Taiwan's central government (i.e., the Ministry of Finance and the Ministry of Education), or the questionnaire can contain more questions related to later life, the further study would benefit by giving a longer period of time to evaluate immigrant's integration in broader areas, which would also significantly increase the contribution and value of empirical analysis.

Second, the immigration decision itself is the result of self-selection, which is influenced by both observable traits such as ethnicity, experience, cognitive skills such as education and work skills, and unobservable traits or factors that are difficult to quantify, such as cultural distance and social networks, which can lead to biased results in a way that the researcher may not be able to control [144]. Although we can control the observable characteristics in research, the unobservable others could still mix the empirical results with some confounding factors. As such, improving the comprehensiveness of the data and the measurement of the currently unobservable factors would lead to more convincing interpretation of the empirical results in future research.

Finally, in the dissertation, our empirical analysis can only capture the individual and family characteristics while leaving behind the influence of structural factors. For example, the segmentation in labour market, which illustrates the division of adult's labour market outcome by occupation, industry, or spatial or geographical factors. Likewise, children's educational outcomes could also be different in the area to which children belong. Many of these factors are not available for the current data, and they would somehow affect the performance of empirical results. Therefore, the current results should be interpreted without ignorance of structural factors. For the development of future research, one can search for the data with a better comprehensiveness and advanced methodology to identify the impact of these structural factors.

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